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New Advertisements.

In the growth of THE ELECTRICAL WORLD in circulation, size and general improvement, the value of its columns for reaching those engaged in electrical pursuits or interested in electrical matters has not failed to be appreciated by advertisers. Readers will find it to their advantage to keep their eyes on the advertising as well as the reading columns. The following are the new advertisements in this issue:

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Vol. IX. NEW YORK, JUNE 11, 1887. No. 24.

THE ease with which watchmen can be overpowered makes it important to provide some means for indicating to others their condition. Express messengers have, of late, been specially liable to attack, but with the device described in another column very few minutes can elapse without an alarm being sounded in case of necessity.

STEPS have been taken with a view to the consolidation of the leading local electric light interests in New York, after the manner of the combinations recently effected in Philadelphia and Boston. A little later we may be at liberty to print the details of this important arrangement, to which many events of late have pointed.

DURING the past week, the old familiar rumors have been revived as to important movements about to be made in telegraph matters. Once again Western Union is said to be obtaining control of the Baltimore & Ohio, or, to put the report in better shape, it is alleged that Mr. Gould has been advancing money in connection with certain railroad transactions, and has received Baltimore & Ohio telegraph stock as security or collateral. All of which is interesting, if true.

THE spectacle was recently seen of the mayor of New York City speaking of the electric light in terms of the highest praise as a convenience, a factor of safety, and a relief to the police force. Now we have the mayor of Chicago finding in the electric light a special means for dealing successfully with the problem of rendering the Chicago River more available for traffic purposes, and of preventing the delays to business and travel that are now so common and frequent.

THE electric light continues to advance as a defensive implement of war, the German authorities having recently added a new machine to their military equipment. It is a portable combination of a steam-engine, dynamo and large reflector, which will be used for the purpose of projecting a strong light in front of important works so as to guard against surprise. What with the field telegraph, the electric light, and the future electric gun, the army electrician will have his hands full.

THE methods of applying electricity not only to the preservation of the easily attacked metals, but also to working them into desired shapes, are constantly increasing. Not long since we described Prof. Elihu Thomson's ingenious process of electric welding and now we have to chronicle still another method in which the heat of the electric arc is employed as a medium for replacing the drill and planer, and other mechanical means for working metals. It may, of course, take time before these various processes gain their place as regular facilities of metal working establishments, but that they will eventually find their proper rank seems to be tolerably certain.

THE make-and-break telephone transmitter described in another column presents a most interesting study in telephony. In order to render the action of the make and break clear, the inventors have arranged the action so that in their normal condition the transmitting points are in a constant state of vibration, and the sound waves set up by the voice so modify these vibrations as to make them correspond to the spoken sounds. It is evident that the automatic vibrations could be produced by mechanical means instead of the electrical one employed, but the latter is, no doubt, preferable. The articulation of the instrument is said to be remarkably clear.

IT was remarked on this page last week that there was still room for missionary work in the electric light field. An evidence of this truth has been put in our hands by one of the leading electric light companies, whose apparatus is known the world over. One of its correspondents writes: "I want some information on your lamps. How are they used? Do you burn oil or gas? Please write me how they work." Another sapient individual sends a request for "a sample of the goods," with directions how to use them. Probably no one thing distinctive of this age has been more talked about and written upon than the electric light, yet here we are afforded another proof of the fact that time must elapse before any great idea can filter through every stratum of the public intelligence.

IN this issue appears the last of the series of articles on the electrical industries of Mexico. The present article deals with telegraphy, and gives some interesting information under that head, as the others preceding it have done with regard to electric lighting, telephony and miscellaneous applications. It may be pointed out as the leading fact, that Mexico has no electrical manufactures, and is, therefore, wholly dependent on foreign countries for her supplies of electrical apparatus. That our own country should be in a position to meet the various electrical wants of Mexico has been made clear, but while we are getting a share of the trade already, European countries still do no small amount of electrical business with Mexico that should, in the natural course of things, be ours too.

IN an article appearing in a late issue, Mr. Rankin Kennedy described the most recent form of transformers, and gave some general rules for their construction. These, very simple in their nature, might be said to be empirical, and hence those who desire to go deeper into the subject and inquire into the exact relationship of primary and secondary coil, and the iron entering into the combination, will find much to interest them in the article by Mr. Gisbert Kapp on another page. In constructing the characteristic of the transformer, much the same analogy is presented as in plotting the curve for the dynamo. The number of current alternations in the coil is analogous to the speed of the dynamo, and in the same way as we have a "critical speed" for the latter, there is probably a critical point in the number of alternations at which the transformer is self-regulating; besides still other points of maximum output and efficiency depending upon the same factor.

ONE of the most important patent decisions of recent years is that rendered by the Supreme Court a few days ago sustaining the driven well reissued patent, 4,372. The interests involved are very large, it being estimated that there are in the United States nearly 1,000,000 driven wells, every one of which constitutes an infringement of the patent, under the late decision. The agitation caused by attempts to collect royalties under this patent and that on the barbed wire fence has had more to do than any other cause with bringing about the hostility to all patents which is prevalent. No doubt the decision will be received with disfavor in some parts of the West, but friends of the American patent system will look upon it, broadly, with satisfaction. Some of them had begun to fear that the chances were all against upholding any patent which happened to affect the interests of a relatively large number of people—that is, any patent of value—and especially so if the patent was a re-issue. They can now take heart again as to a system which has done so much to promote national welfare and prosperity. The decision is worthy of note as being one of the first, if not the first, which has sustained a re-issued patent since 1882.

WE give in another column what may be looked upon as the first authoritative report on the practical working of an electric railway in which storage batteries are employed as a source of motive power. The results arrived at by Herr Huber after a test carried on for seven months are such as to leave no doubt as to the ability of the storage battery system to supplant horse flesh on street railways. The experience of Herr Huber shows that 12,000 miles can be traveled before the accumulators require renewal, and that, including the cost of renewal and all incidental expenses, the system is cheaper than horse traffic in the ratio of 14 to 16.4. As these tests were carried out while the cars were in actual daily service on a difficult road, and hence embraced all the conditions met with in actual practice, the question of the value of the system may be said to be practically settled. When we consider, however, that radical improvements are constantly being made in both the storage battery and the method of its application, it is safe to say that the gain already shown will be considerably increased. Herr Huber is to be congratulated upon the judgment exhibited by him in adopting the system and in the care with which he carried out the tests.

DISTRIBUTION of power, a matter which all electric light companies are interested in, cannot as yet be said to have arrived at a stage of standard practice any more than the electric light itself. In the later department, indeed, recent developments would show that we are still only a mile or two on the open highway. Power distribution, for the present at least, must hold itself close to the main ideas recognized in the electric light business, and the question naturally suggest itself, which method shall be adopted for distribution? The opinion of Mr. W. Baxter, Jr., which we give in another column, is that by employing motors in series with constant current, greater efficiency in the system, due to the method of regulation, can be obtained, his main argument in this respect being based upon the admitted supposition that the motors are not driven to their full power at all times. But, on the other hand, it cannot be denied that the system of constant potential distribution possesses advantages which are not inherent in the former and which we need not enumerate. The thing which seems to us vital at this time is to introduce the motors on *existing* circuits. The question of the best methods of distribution for future power stations pure and simple will, we think, find its solution in the experience now being gained. We do not, in fact, anticipate that either type of motor will prevail to the exclusion of the other, but we do expect to see a vast increase in the number of motors of both kinds on the circuits that are standing to-day.

BOSTON has far outgrown its facilities for street travel, and is now anxiously awaiting the adoption of some plan or agency that will meet its necessities. A recent article in the Boston *Herald* brings this point out very clearly: "The complicated street car system is quite as prominent a feature of Boston," it says, "as the streets themselves, which are so largely monopolized by this out-grown method of passenger transportation; but to judge from the persistent efforts which are being made for the further extension of this system, perhaps no immediate relief can be expected, however welcome such an event would be to a majority of the citizens. Yet a limit will eventually be reached when absolutely no further extension will be possible, and this method of transportation will be totally inadequate for the needs of the city. In support of this assertion it is sufficient to mention that the number of passengers carried by the Metropolitan road alone has nearly doubled in the past decade. It now carries about 40,000,000 passengers per annum, against 20,000,000 ten years ago. It is to be hoped that an easy solution of this problem will be availed of before the time arrives when horse cars cease to further encroach upon the streets merely because there are no other streets to be encroached upon." The fact is brought out that within a half-mile circle, with the Boston City Hall as its centre, there are no fewer than forty streets occupied with horse car tracks, and subject to all the annoyances that accompany the use of horses for city travel. It is high time, indeed, that resort was made to electricity, which is, beyond a shadow of doubt, the one means for dealing with the matter successfully, and for giving Boston a system of intramural passenger service of which she can be proud.

House Fund of the American Institute of Electrical Engineers.

We publish below the list of subscriptions to the House Fund of the American Institute of Electrical Engineers to June 7. It will be seen that the work is going on hopefully and steadily.

LIST OF CONTRIBUTIONS.

Prof. W. A. Anthony	$ 50
C. Batchelor	100
C. S. Bradley	200
W. M. Callender	100
C. A. Cheever	100
W. B. Cleveland	50
Curtis & Crocker	100
T. A. Edison (first)	100
S. D. Field	100
W. K. Freeman	50
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F. B. Herzog	250
" (Conditional)	250
C. B. Hotchkiss	200
W. T. Hunt	10
W. J. Johnston	500
E. H. Johnson (first)	100
F. W. Jones	100
Julien Electric Co. (Wm. Bracken, pres.)	100
T. C. Martin (first)	100
Capt. Michaelis, U. S. A.	20
J. F. Morrison	200
G. M. Phelps	100
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R. W. Pope	100
Pope, Edgecomb & Terry (first)	250
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F. J. Sprague	50
C. E. Stump	100
W. C. Temple	25
Prof. Elihu Thomson	100
F. R. Upton	50
E. Wagemann	25
W. Wallace	100
J. Wetzler	100
S. S. Wheeler	100
Edward Weston	250
Total to June 7	$4,345

With regard to the movement, the *Railroad Gazette* says:

The American Institute of Electrical Engineers is proceeding energetically to establish a fund for permanent quarters, where it can have a meeting place and begin to build up a library and a technical collection. Nearly $4,000 has already been subscribed for the purpose. The spirit of this brisk young society is commendable, and no doubt it will succeed in providing itself with a home which will be pleasant and profitable. There is, however, a larger aspect to the subject. A union engineering library has been more or less talked of for some time, and several of the technical journals have lately discussed the topic. There are now many scientific and technical organizations with headquarters in New York, whose interests are closely allied, and who have much in common in their labors and in their literature. As they now have no common plan of organization, they are wasting a good deal of energy, and as their libraries and collections grow they will waste more. The American Society of Civil Engineers has a comfortable house and a valuable library, but its meeting room is crowded on ordinary occasions and it is frequently entirely inadequate to the society's needs.

Why should not the Civil, Mining, Mechanical and Electrical Engineers and the societies of the Architects and the Chemists unite in making a home of the arts and sciences sufficient to their needs and creditable to the city? With their combined resources they could soon have a well-arranged and well-catalogued library, and a commodious hall for use in common, while committee rooms and smoking rooms would provide for the informal intercourse of off-nights.

There is no doubt that such a project would be aided by public-spirited citizens outside of the societies if such aid were sought for. In the American Society of Civil Engineers there has always been a strong and proper spirit against asking any such aid; but the society might, with credit, and no loss of self-respect, share in the advantages of a house and library such as are suggested here, even if they were partly the gift of individuals not members of either of the scientific organizations.

The movement has also been greeted with approval by *Science*, the Chicago *Industrial World* and other leading papers.

NEW BOOKS.

LESSONS IN ELEMENTARY PRACTICAL PHYSICS. By Prof. Balfour Stewart, M.A., LL.D., F.R.S., and Prof. W. W. Haldane Gee, B. Sc. Vol. II., ELECTRICITY AND MAGNETISM. Macmillan & Co.: London and New York.

One of the authors of the present volume is already well known. The student of natural science who has read the classical work of Prof. Balfour Stewart on "The Conservation of Energy" will have found the author a learned physicist; and if, besides, he has studied his "Primer of Physics" he will also have found in him a great teacher. The minds laden with the richest burdens of scientific thought and knowledge are so often those the least endowed with the faculty—we might say gift—of handling this knowledge so that others may grasp it easily and readily, that an author who excels at the same time as a *savant* and as a teacher, enjoys the possession of qualifications sufficient of themselves to render attractive any work to which he may devote his pen. This talent for authorship is very ably supplemented by a talent for experimentalization on the part of the associate author, Prof. Gee; and, doubtless, the excellence of the book is greatly due to this fortunate co-operation.

The authors had already published some time since the first volume of their "Lessons in Elementary Physics," under the title of "General Physical Processes." The present volume is the second part of the treatise, and it is to be followed soon by a third part, on "Optics, Heat and Sound." Each volume, however, though it forms part of a comprehensive treatise, may be taken by itself as a distinct treatise on the subjects it deals with. Thus, Volume II. might not inappropriately be renamed a "Text-book" or "Manual" of Electricity and Magnetism. The book is specially intended for use as a text-book for classes in elementary physics, and for pupils and students generally; but it could scarcely have been more well designed and arranged if it had been specially intended for that great body of searchers after knowledge who cannot see principles elucidated and demonstrated in the laboratories of skilled experimentalists; who, indeed, must dispense even with teachers; whose only resource must be books and their own ingenuity in their endeavor to acquaint themselves with the fundamental principles of the science in which they are interested.

The method of teaching adopted by the authors will have a peculiar interest and charm for this class of readers. The book is in reality a series of object lessons each of which is calculated to interest the student by reference to something being done. In this way the senses all assist to impress forcibly upon the mind the principles exhibited in the lesson. The experience of Professor Gee as demonstrator in physics, doubtless serves a most valuable purpose here, and his ingenuity in improvising apparatus for these lessons is made evident on almost every page in both text and illustration. This practical, or rather natural method of teaching theory is not alone effective in training the senses to assist the memory, but it is useful in convincing the student of the fact that great fundamental principles are sometimes quite as profitably studied with simple devices as with elaborate facilities for demonstration. The authors in this way give the student confidence and encourage him to make new experiments with apparatus of his own devising.

In their preface the authors mention certain features which they appear to have kept in view: 1. Much of the apparatus described is of a simple character, such as can be readily made in the workshop of a physical laboratory without special appliances. 2. They have restricted themselves, as a rule, to a few typical methods and typical instruments. 3. Copious references to fuller sources of information have been given. 4. Additional exercises are given, calculated to lead the student on to some branch of original work. 5. Theoretical explanations have been entered into, more especially where it was necessary that the ordinary work should be supplemented.

In the first three chapters are laid the foundations or ground work of the whole volume, in a preliminary review of the main principles of the science, the first chapter relating to static electricity, the second to magnetism, and the third to voltaic electricity. In the succeeding chapters the authors extend the boundaries of action of these fundamental principles by exhibiting them under different and varied conditions in new experiments or applications.

The book contains nine chapters. To exhaust the subject matter which can be derived from the first three chapters, doubtless many more chapters would have been required. But as the work was not intended to be exhaustive, the authors prefered to devote the space to fewer divisions of the subjects. One cannot help wishing that they had presumed to fill more space, seeing what good use they can make of it. As it is, the space is very intelligently occupied with such divisions of the subject as should be included in an elementary course. Chapter IV., the Measurement of Resistance; Chapter V., the Tangent Galvanometer; Chapter VII., Electro Magnetism and Electro-Magnetic Induction; Chapter VIII., the Condenser, will be found of special interest to practical men, who will find there many things made clear that are left obscure in more pretentious works. Chapter VI., Determination of the Magnetic Elements, and Chapter IX., the Electrometer, though of not such practical usefulness, are none the less important and indispensable to the student of physics. The book is supplemented by very interesting appendices that undoubtedly add "value and authority," as Mark Twain would say. Appendix A is particularly interesting, as it gives a full and clear analysis of Kirchhoff's laws and the theory of the Wheatstone bridge, calculated to bring these principles within easy reach of the student. Appendix D (standard cells and comparison of E. M. F.), and Appendix F (practical details relating to manipulation) also deserve "honorable mention."

Our most serious objections to the work all spring from the same source, and they are intimated in the regret that the authors should have neglected opportunities to point out the practical applications of the principles they so clearly expound. They evidently desired to remain strictly within the boundary lines of the domain of pure science, and no experiment or illustration has been drawn from the domains of applied science whenever it was possible to find one of a more classical character. This circumstance gives to the work a classical tone of color, which perhaps was intentional, in a text book for classical schools. Yet, while the multifarious applications of electricity have no interest to the physicist except as exponents of certain fundamental principles, they can be of much greater interest and value to the student. There is not to be found in the book a word of reference, either by way of explanation or illustration, to the electric light, the dynamo-electric machine, the telephone, or the many other milestones in the path of applied electrical science. These are the very things too that conspire to rivet the attention and the interest of the pupil, for he already has heard, or knows something of them, and is eager to learn more. In treating of the galvanometer, for example, a passing mention of the ampère-meter and the voltmeter, would not, even in a classical work, have been an intrusion, and doubtless the student would have been grateful to learn what he might not have realized before, that these instruments are a kind of galvanometer. This apparent disdain of the pure scientist to touch the practical detracts undoubtedly very much from the value of his work, and in our opinion the present volume has lost much force and aptness of illustration in this way. It is here only, as stated above, that we have fault to find. In other respects we have nothing but words of praise to express, and we think that every electrician and student will find it, taken as it is, a valuable guide on his journey to the goal of knowledge.

TECHNOLOGY QUARTERLY. Published by the Senior and Junior Classes of the Massachusetts Institute of Technology, Boston, Mass.

We welcome most heartily the first number of the *Quarterly*, as we recognize in it a decidedly valuable accession to the already large number of college periodicals. The generous quantity of original work done at some of our institutions of learning is often wasted through a lack of a suitable channel of publicity. The Massachusetts Institute has now grown to such proportions, and its laboratories have increased to such a number, that the students feel warranted in undertaking the publication of information as to the original work done in them. We find the contents of the *Quarterly* therefore of a varied nature, including papers on chemistry, physics, electricity, engineering and even biology. The issue at hand contains two articles devoted to electricity—one on the "Efficiency of Small Motors," by H. E. H. Clifford, S. B., and one on the "Correction Factor of a Galvanometer Coil when the Needle is Displaced along the Axis," by J. J. Skinner, Ph. D. Both articles are well written and show care in their preparation. With Prof. Cross in charge of the Rogers Laboratory of Physics and directing the students, there ought to be no lack of good electrical contributions to the *Quarterly*.

Studying Earthquakes by Electricity.

BY PROF. JOHN MILNE.

In reference to the articles published in the ELECTRICAL WORLD (Vol. IX, Nos. 11, 12, 13, 14) on the subject of earthquake machines, I beg to make the following remarks:

1. I have visited Italy for the express purpose of seeing the instruments used by Palmieri, Rossi, Bertelli and other seismologists. From time to time, I and others in Japan have experimented with many of the Italian instruments. I am acquainted with, I think, nearly the whole of the papers in which these instruments are described and *discussed*.

2. The conclusion I come to is that they are neither seismometers nor seismographs, but simply earthquake indicators or seismoscopes. This opinion is shared by the earthquake bureau of the Japanese meteorological department, who have discarded the Italian instruments, and like the Professors of Seismology in the University of Japan, and like all workers in this part of the world, have adopted instruments which give *absolute diagrams of each vibration and consequently absolute measurements of earthquake motion*.

3. The time-recording apparatus is as obsolete as the instruments. By electrical methods we record to the second, without stopping or starting a clock, the time of some particular vibration in a disturbance. The necessity for this accuracy is apparent when we remember, first, the difficulty in comparing clocks situated at distant stations; second, the enormous velocity with which earthquake motion is propagated; and third, that an earthquake is a movement seldom extending over less than 30 seconds, often one minute and sometimes even 5 or 10 minutes. To describe the instruments used in Japan, how they have gradually been reached, the tests to which they have been subjected and why many have been discarded, would be to write a history. Seismometry alone recently formed the subject of ten lectures in this country.

Those who are interested in the methods of earthquake operation may refer to the Transactions of the Seismological Society of Japan, vols. i.–xi.; an epitomized account of seismometry in the volume on earthquakes, published in the International Scientific Series; *Nature*, Oct. 26, 1882, etc.

IMPERIAL COLLEGE OF ENGINEERING, TOKIO, JAPAN.

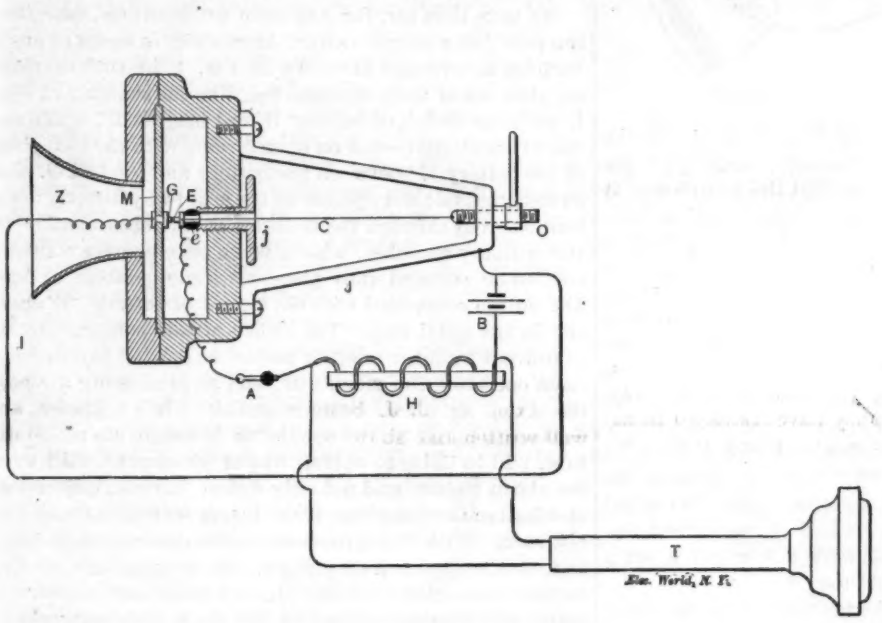
A New Make-and-Break Telephone Transmitter.

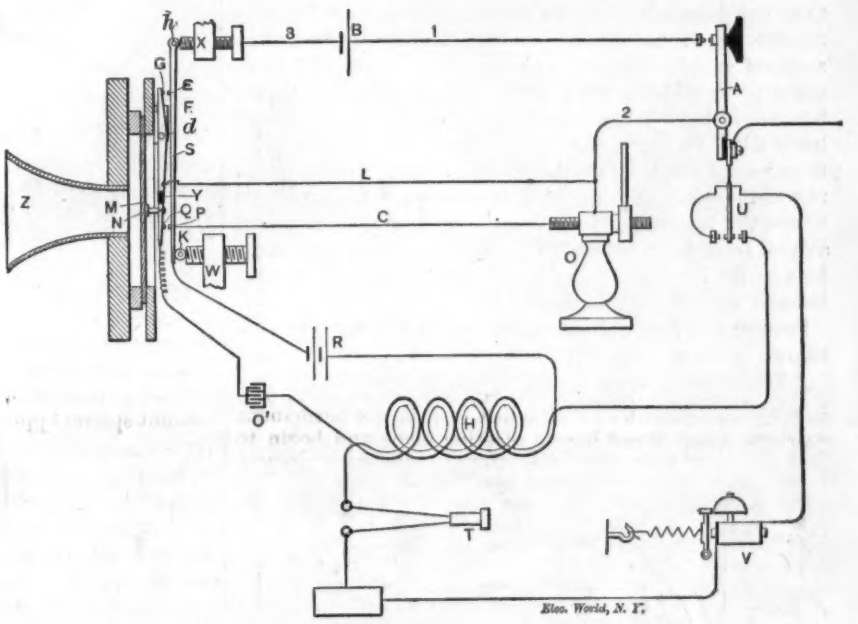
What the action in the telephone transmitter is has been the subject not only of much controversy but of arduous research. The theory of Professor Bell that articulate speech can only be transmitted by variations of a continuous current, *i. e.*, an undulatory current, has from the beginning been denied, and a number of forms of apparatus have been constructed to prove the contrary. These "make-and-break" telephones, as they are called, have as a rule been so constituted that the makes and breaks are effected by the action of the sound waves impinging against a diaphragm to which the contact point is attached.

In order to make the action of the make and break entirely clear, Mr. Stephen D. Field, the well-known electrician, and Mr. Rudolph Eickemeyer, of Yonkers, N. Y., have recently constructed a telephone transmitter in which the transmitting points are not in contact when the instrument is at rest.

The instrument is, in fact, an automatic circuit breaker, which automatically makes and breaks an electric circuit with a rapidity too great for its effects to be appreciated by the ear. A diaphragm is then arranged so that sound waves projected against the same are caused to bridge over more or less of these makes and breaks of the circuit in proportion to the rapidity with which the sound waves succeed each other.

The instrument, which is decidedly novel in many respects, is shown in Fig. 1. The diaphragm *M* supports a platinum contact point *G*. The mouthpiece *Z* is attached to the front of the instrument and sound waves entering strike against the diaphraghm *M* carrying the contact *G*. The contact point *E* is cushioned against a soft rubber cushion *e*, which is of spherical shape, and is provided with a perforation, through which the fine wire *C* passes for attachment to the contact piece. The wire also passes through a hollow screw *j*, which is set into the head of the telephone, and an adjusting screw *O* regulates the tension upon the rubber cushion through the wire *C*. The apparatus also comprises the usual battery *B* and induction coil *H*, together with a switch.





FIGS. 1 AND 2.—A NEW MAKE AND BREAK TELEPHONE TRANSMITTER.

It will be seen that the circuit of battery *B* passes normally through the insulated metallic frame *J* of the telephone and the wire *C* to the contact *E*. It will also be observed that there is a short circuit by way of wire *I* between the contact point *G* and the frame *J*. The tension of the wire *C* is normally sufficient to separate the points *E* and *G*. When, however, the switch *A* is closed, and the current from battery *B* passes over wire *C*, the latter will heat and expand, and allow the points to come into contact. The current will thus be shunted around the wire *C* through a path of approximately no resistance, and as a result, the fine wire, becoming cool, will contract and separate the contact points. The apparatus thus becomes a circuit breaker, working with almost inconceivable rapidity so long as the current from the battery *B* continues to circulate. The makes and breaks are so rapid as to pass beyond the limit of receptivity of the ear.

Now, it is evident that sound waves striking upon the diaphragm *M* will alter the relative positions of the points *E* and *G*, tending to prolong their respective contacts. These prolonged contacts will produce effects which are audible, and, if they follow each other in the proper sequence, articulate speech will be transmitted and reproduced in the receiving instrument.

The object of the cushion *e* is to render the apparatus more sensitive as regards the action of the wire *C* in response to successive heating and cooling.

The cushion forms a sufficiently rigid home for the contact *G*, and is, at the same time, sufficiently yielding to respond quickly to the expansion and contraction of the wire *C*. The diaphragm *M* is an insulating diaphragm of wood.

In another form of apparatus embodying the same principle and shown in Fig. 2, the points *E* and *G* are supported respectively upon levers *S* and *F*, the former being pivoted at *h* and the latter at *d*. The relations of the two levers can be adjusted by means of the screws *W* and *X*, the former of which bears against the lever *S* at one end and the latter against the rubber spring *K*, which is located between the other end of the lever and the screw *W*. The circuit of battery *B* in this apparatus, when the key *A* is closed, passes by way of wire 1, key *A*, wire 2, adjusting screw *O* and fine wire *C* to the lever *S* and back to the battery by way of the screw *X* and the wire 3. The closing of the key will, therefore, cause the current of battery *B* to pass through the wire *C*, thus heating and causing it to expand. The wire will accordingly be lengthened, and the tension upon the lever *S* will be relaxed, allowing it to move towards the lever *F* by reason of the pressure exercised upon it by the rubber spring *E*. If this lever movement continues far enough, the points *E* and *G* are brought into contact, closing a short circuit around the wire *C*. The short circuiting of the wire *C* will cause it to cool and contract, and thereby break the contact between the points *E* and *G*, whereupon the above operation will be repeated automatically as long as the key *A* is kept closed. A sound wave striking upon the diaphragm *M* will, therefore, tend to cause a separation of the contacts *E*, *G*, and to prolong the expansion of the wire *C*. Now, the lever *S* carries besides the contact point *E*, a point *P*, which is located exactly opposite a similar point *Q* on the lever *F*. The action by which the movements of the diaphragm tend to prolong the expansion of the wire *C* will, accordingly, tend also to prolong the contacts of the points *P* and *Q* when the latter is moved toward it by a movement of the diaphragm due to the effects of a sound wave. The condenser *O'* is included in the battery circuit to prevent sparking.

By employing a thin diaphragm, and sealing up all the works in a heavy cast-iron box to cut off outside vibrations, the apparatus may easily be made to serve as a telephone repeater. The diaphragm is then arranged with an electro-magnet in proximity to it, the magnet being included in the line over which impulses are being sent.

The idea embodied in the invention is, that the fine wire *C*, with its connected contact point, forms an automatic circuit-breaker whose makes and breaks produce no audible effects upon the circuit, by reason of the great rapidity with which they follow each other. That is to say, the normal vibrations of the circuit-breaker, considered with respect to their capacity to reproduce sounds, are neutral or inharmonious. That which reduces them to harmony and enables them to reproduce sounds in a receiving instrument are the devices which bridge over or throw together more or fewer of the inharmonious vibrations and thus alter their natural sequence.

The Electrical Industries of Mexico.

BY W. J. JOHNSTON.

4.—(*Conclusion*)—*Telegraphy.*

I found much more activity in the telegraph business in Mexico and a considerably more extensive network of wire than I had expected. There are several different systems of telegraphy in the republic. The Federal lines are, of course, the most important. In addition to those operated by the government, there are quite a number of local lines which have been turned over to the different States under an arrangement advantageous to the Federal government. The railroad companies, moreover, have their own telegraph lines along their entire length. The Mexican Central alone has more than 1,200 miles. Then there is the Mexican Telegraph Company, which is really a cable company. The rates in Mexico are all made by the government, and are based upon distance. The lowest charge for local messages, or between points but a few miles apart, is 15 cents, which is reasonable enough, but where a message has to be transmitted a long distance the rate is quite high—very much higher than in the United States. The cost of ten words from the City of Mexico to New York is, if I remember correctly, $3.75—and this is a competitive rate—while from El Paso or Galveston, Tex., the rate to New York is only $1, leaving nearly $2.75 Mexican money for transmitting the message less than one-third of the way.

The disparity in the cable rates is, however, very much more marked. From the city of Mexico to England, for instance, the charge is 45c. a word. Of this the Mexican Telegraph Company or the Mexican Central Telegraph Company—the rates by both routes are the same—get 31c. a word for transmitting the message to Galveston or El Paso, respectively, while the Western Union has but 14c. a word in Mexican money left to transmit the message to New York and under the ocean to England. The government prohibits the regular telegraph companies from transmitting public messages between points where it has offices. Every message must also bear a one cent revenue stamp, and if the dispatch relates to or is an order to pay money, it must have extra stamps attached according to the amount involved. Mexico has numerous and original methods of collecting revenues. It places no tax upon real estate, but it seems to tax about everything else.

I had a pleasant chat with Senor Saturnino Islas, the general manager of the Federal telegraph system of Mexico. He is a younger man than one would expect to find in such a position in Mexico, and he is full of vim and enthusiasm and struck me as possessing a high degree of executive ability. He speaks English fairly well.

Senor Islas told me that there are about 16,000 kilometres (12,000 miles) of wire under his charge, and that there are 220 different federal telegraph offices in the republic, giving employment to about 400 operators.

He said that about half the messages transmitted were on account of the government, the other half being private messages paid for by the public. In answer to a question as to how much revenue was received from the public, he said that about 25 per cent. of the expenses of operation were received as tolls for the messages transmitted for the public. This would not imply that the telegraph system was profitable; on the contrary, it would show quite a serious deficit. The government, however, does not expect the lines to pay. Many of them were constructed principally for military purposes, and are not commercially profitable. In addition to this, the government is, and has been for some time, reconstructing its old lines and also building new ones, so that the outlay is probably considerably higher in proportion at the present time than it will be some years hence. The supplies for the government lines formerly came from Paris, but now most of them come from the United States. Cables, however, come from England.

The central office in the City of Mexico is in a handsome new building on the prominent thoroughfare known as the Fifth of May street. Twenty operators are employed in the operating room, the hours being from eight to eight. The pay of ordinary operators runs from $50 a month up to $75, the manager and chief operator, of course, getting larger amounts, the highest pay in the operating room being $150 a month.

Some time ago Mr. F. R. Guernsey, of the *Mexican Financier*, wrote for the Boston *Herald* a very interesting account of the federal telegraph system of Mexico, in which he remarked, very truly, that the telegraph lines and the railways have made it almost impossible for a revolution to get started in Mexico, owing to the fact that the minister of war is at all times in communication with the most distant points of the republic; so that, should a revolt break out, the swift locomotives are ready to haul the troops to points 1,200 or even 2,000 miles distant, transporting regiments in two days over hot plains where, six years ago, an army would have had to move with great

slowness, thus giving time for a rebellion to get well under way before the hand of the Federal government could be felt. By the Central railway, troops can be put into the City of Chihuahua in two days, as against a month and a half six years ago. This enormous gain in time afforded by the telegraph, in bringing the news, and the railways, in transporting the troops, has increased the efficiency of the army many fold. Indeed, in the old days, swift couriers, riding day and night from the Rio Grande, would have consumed at least 20 days in reaching the seat of the Federal government, and after that the time above mentioned would have had to be consumed in putting the troops there, with the disadvantage of having to pit worn and exhausted soldiers against rebels in good physical condition, unworn by forced marches across hot plains covered with ankle deep sand. The rainy season, Mr. Guernsey adds, does not so completely paralyze interior trade as formerly, for the locomotive has overcome natural obstacles. In a word, Mexico is being revolutionized by the iron horse and the electric wire. The telegraph system of Mexico has been increasing in extent ever since Gen. Diaz's first accession to the presidency in 1876, and with the introduction of the railways has become more and more important.

Referring to the old order of things before the service was reorganized, Mr. Guernsey says he is "quite sure that in those days one-half the messages were put in the operator's pocket, while the other half went directly to the man in the moon. Certainly very few people ever got a message within ten days or more after it was deposited at the office of the sending point. Outside the office, out on the lines, things were even worse. There were reported on Mr. Islas' taking charge of the federal system, 50,000 and odd prostrate poles, and miles on miles of line minus the wire. The festive peon, in his hours of relaxation, cut down the poles for fire wood and used the wire for fencing in his poultry or cattle. There were whole sections without linemen to keep the wires up and to replace poles. There were little offices with hardly any business, places which in England or the States would have a boy or young woman to manage them, where five men were loafing away their useless time, drawing salaries as favorites of some brisk politician. Almost everywhere the instruments were antiquated and the batteries almost good for nothing. The government had spent millions on the lines and in salaries, and had little but paper lines to show for all its money."

Speaking of Señor Islas, after he had been placed in charge of the service, Mr. Guernsey says:

"The young general manager went to work like a man

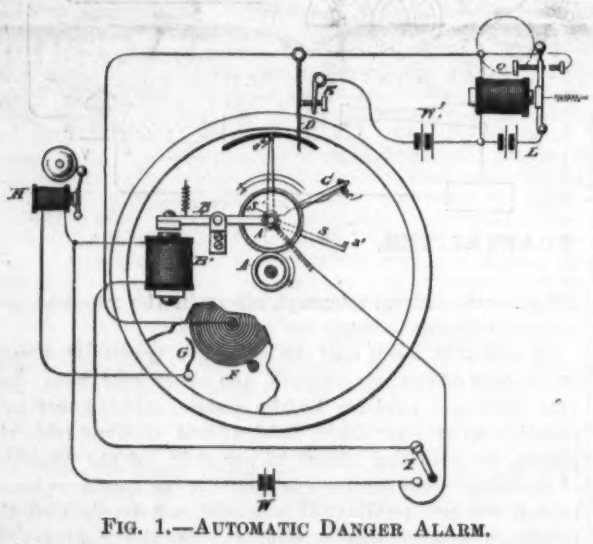


FIG. 1.—AUTOMATIC DANGER ALARM.

who knows that the axe has got to be laid at the foot of the tree. And he had an axe. It chopped off heads faster than a machine-run guillotine, and the professional politicians marched off into the shadows of obscurity in a long procession. Poles went up all over Mexico as if a magician had waved his wand, wires stretched themselves over the plains of the northern tableland and through the dense jungles of the hot country. Everywhere, the service felt the inspiration of a master mind. An esprit de corps was created. Men felt proud to work in the government telegraph service. Before long, the public began to find that the government actually could send a message to some other place than the moon. Merchants in distant cities found out that the mail no longer beat the wires. It was an unexpected discovery, but it was made, and the revenues of the service began to augment."

General Manager Islas, says Mr. Guernsey in conclusion, is an alert, business-like man, with an American way of doing things, and his head shows executive capacity. He is one of the progressive young men who are pushing Mexico into the arena of go-ahead nations. That the civil service idea, which has been tried and proved sound in the telegraphic service of the government of Mexico, may be extended into other departments, is to be hoped. There is a strong feeling among influential statesmen in favor of this reform, but work has got to be done slowly, for the old system is thoroughly rooted in the very groundwork of the political structure.

The Mexican Telegraph Company has a land line from the City of Mexico to Vera Cruz, and a cable from Vera Cruz to Galveston, 800 miles. At Vera Cruz, connection is made with the Central and South American Telegraph Company, which has a cable to Lima, 3,300 miles. This in turn connects at Lima with the West Coast Telegraph Company of America to Valparaiso, 1,800 miles. About 150 messages a day are handled in the City of Mexico office by two operators. Mr. C. E. Cummings is the manager. Vera Cruz has eight operators. Chas. H. Baker is the manager at Vera Cruz, while Mr. H. G. Wilson is superintendent of the lines from Galveston to Salina Cruz.

An Automatic Electric Danger Alarm

The numerous robberies of express messengers on board railroad trains and the robbing of banks, rendered possible by the overpowering of the watchmen in both cases, makes some alarm apparatus by which this can be prevented of undoubted interest and value. The ordinary watchman's alarm does not provide for such an emergency, and hence an automatic danger signal is of importance in connection with such an apparatus. Such a one has recently been

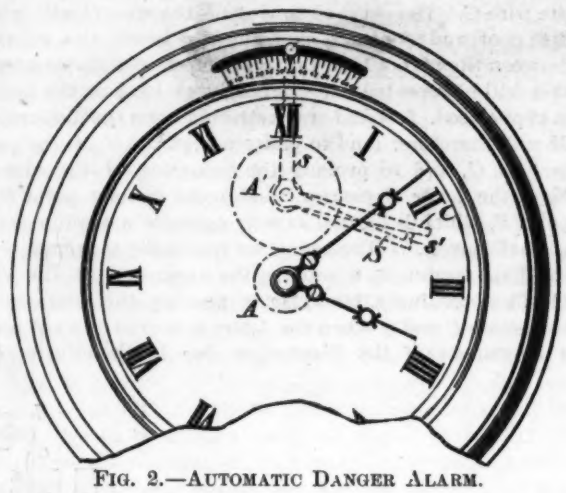


FIG. 2.—AUTOMATIC DANGER ALARM.

designed by Mr. John J. Ghegan, of Newark, N. J. In the apparatus invented by Mr. Ghegan, the sounding of the alarm is designed to indicate either that the watchman is negligent of his duties or that he is in danger and unable to prevent the sounding of the signal as he is required to do.

The apparatus by which this is carried out is shown in the illustration, Fig. 1. A clock-work has the friction wheel A secured to the shaft of the minute hand, and resting in contact with it is the friction wheel A'. The latter is pivoted to the outer end of the armature B of the magnet B', which is in the normally open circuit of a battery W, which circuit includes a switch-circuit closer I.

Ordinarily the armature is away from the poles of its magnet, and the wheel A' is in contact with the wheel A. When, however, the magnet B' is energized, the wheel A' is lifted out of contact with the wheel A for a purpose which will be explained later.

The clock-work is so connected with the shaft of the wheel A as to cause it to rotate in the direction of the single arrow. As a consequence the wheel A' rotates in the direction indicated by the double arrow, and carries with it an arm C attached to it. On the arm is an insulated metallic pin c, which is connected with a branch circuit of battery W, as shown.

In the path of the movement of the arm C is located a spring terminal D which is normally in contact with a corresponding spring terminal E. These springs form part of a circuit of a battery W', which circuit includes a bell O. The circuit W' is normally closed and the armature of the bell O is normally on its front stop. In circuit with the same bell O, and with its armature and back stop is a local battery L. The rupture of the circuit of battery W', the "alarm circuit," releases the armature of the magnet O and allows it to fall upon its back stop, thus throwing it under the influence of the battery L and causing a vibratory movement of the armature. When the pin c in its motion comes in contact with the spring D its tendency is to ruptnre the alarm circuit between D and E; but this tendency is resisted for a time by the elasticity of of the spring and by the fact that the spring E follows the spring D for a little distance. If, however, the pressure is continued long enough and the wheel A' allowed to continue its rotation, a rupture will soon take place at the point indicated and the alarm will be sounded.

The derived circuit of battery W, already referred to as including the stop c, also includes a tap-bell H, a spring G, and the hair-spring F of the clock-work, as well as the spring D itself. When, therefore, contact is made between c and D, this derived circuit is completed, assuming, of course, that the hair-spring F is in contact with the spring G.

As a matter of fact, the hair-spring is so arranged as to make contact with the spring at every complete pulsation or vibration. The result will be that so long as c and D are in contact there will be successive taps upon the bell caused by a closure of the circuit between F and G at every pulsation of the hair-spring.

The sounding of the tap-bell H is an indication to a listener that the alarm-circuit is about to be broken unless measures are taken to prevent it. If, now, an operator turns the switch I and closes the circuit of the magnet B', the armature B will be attracted, the wheel A' will be lifted out of contact with the wheel A, and under the influence of a spring (not shown), or gravity, the wheel A' will be restored to its original position and the alarm-circuit will remain unbroken.

The switch I and the tap-bell are both located in the same apartment with the person to be protected. As soon as he hears a sound of the tap-bell it is his duty at once to connect the switch I and restore the apparatus, as above described.

By regulating the distance to which the wheel A' shall fall back at each restoration, the intervals at which the watchman shall be required to operate the switch can be predetermined. A detent-lever S is pivoted upon a post s, the lever being bent at one end to form a detent s' in the path of the arm C. This detent-arm can be swung upon its pivot, so as to bring the detent s' to any desired point in the range of motion of the arm C. The nearer this end is adjusted to the spring D the shorter will be the distance traversed by the arm C in its return, and the shorter will be the time required to pass into contact again with the spring. The other end s of the lever S passes through to the front of the clock-work and there serves as an indicating-finger, to designate, in connection with a scale shown in Fig. 2, the number of minutes elapsing between any two successive contacts.

If the apparatus is set up in an express car and the pointer is set at 10, no more than ten minutes will ever elapse without notice being given on the alarm bell O, which is located on the engine or at any other suitable part of the train, unless the express agent himself prevents such a signal from being sounded, in the manner already described. If, therefore, he is under constraint, or is disabled in any way, in a very few minutes a danger signal will be heard by parties interested in his safety, and measures can be taken to relieve or rescue him.

We have thus far, for the sake of clearness, described the part I as a simple switch. In practice, a series of push-buttons, is arranged as shown in Fig. 3, in such a manner that one of them is connected, like the switch I of Fig. 1, with the circuit of battery W and magnet B', while the others are all connected on open circuit with the two poles of the battery W' between the battery and the bell O. The push-buttons do not operate in the usual way directly upon contacts, but through the medium of switches similar to the ordinary switches, which, when once contact is made, need to be restored into place by some positive action. The button connected with the circuit of battery W operates in the usual way. The object of this construction is to prevent a robber or other person harboring evil designs from operating the magnet B', and so preventing the possibility of an alarm being sounded. Such a person, endeavoring to restore the apparatus through the push-buttons, will be liable to operate one of those connected with the alarm circuit, and not only defeat his own object but also hasten the sounding of the alarm which he desired to obstruct. With this arrangement also the watchman himself, on the approach of danger, can actuate one of the buttons connected with the alarm circuit and sound the alarm bell without waiting for the clock to do its work.

It might be supposed that when the device was applied to use as a watchman's time detector, a watchman might

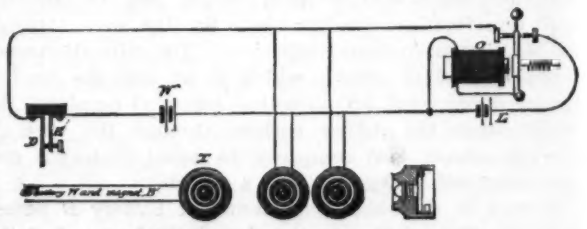


FIG. 3.—AUTOMATIC DANGER ALARM.

permanently close the switch I, and so prevent all danger of the alarm signal not being sounded, by lifting the wheel A' out of contact or engagement with A, through the medium of the electro-magnet B'. To prevent this an ordinary Leclanché or other open-circuit battery is employed at W, which on closed circuit will run down in a short time. It is obvious that such an attempt on the part of the watchman would be detected as soon as the battery W was exhausted. The use of this battery furnishes a safeguard against the misuse of the apparatus by the watchman himself, and the arrangement of the series of circuit closers also renders it extremely improbable that a person not acquainted with the working of the apparatus could take advantage of it to secure his ends.

Articles That Should be Studied.

To the Editor of The Electrical World:

SIR: I would like to indorse Mr. Lockwood's articles on "The extreme importance of attention to little things in telephony." *They should be studied.*

Perhaps an experience of over twenty years in electrical business, eight of which have been in the heat of telephone progress, will lend a little weight.

I. H. FARNHAM,
Electrician N. E. Tel. & Tel. Co.

BOSTON, Mass.

In a Telephone Exchange.—The Fisher Motor is being used to run the generator in the Telephone Exchange at Detroit, and is reported to be working very nicely, and giving entire satisfaction.

The Baxter Electric Motors.

At the last meeting of the National Electric Light Association, held at Philadelphia, there were exhibited in operation a number of electric motors, designed by Mr. Wm. Baxter, Jr., of Baltimore, and made by the Baxter Electric Manufacturing Company, of Baltimore, which attracted considerable attention on the part of the electric light men present. Among those exhibited was the machine shown in Fig. 1, which was connected to an arc light circuit. The machine illustrated is the smallest size built, and is intended principally for running sewing machines, job printing presses, pumps, fans, etc. When intended for pumps, fans, or any other purpose where a constant speed and power are required, it is made without the ring surrounding the commutator and brushes shown in the illustration. This ring is only used when the nature of the work is such that the motor has to be started and stopped very often, or when it is necessary to vary the speed at will. In this case the brush lever is made movable around its axis, and the electrical connections between the field coil terminals and brushes are maintained by springs attached to the brush holders and so arranged that their free ends press against metallic linings on the interior surface of the ring.

A spring attached to the upper end of the brush lever holds it around against a stop. When in this position, the brushes are raised off the commutator, and no damage can be done by turning the armature backwards. At the same time, the contact springs that press against the interior of the ring are in such position as to cut out the armature. The motor is set in motion by rotating the brush lever in a direction opposed to the tension of the spring. The first movement throws the brushes on to the commutator, so that the circuit may be closed before the armature is cut in. In this position, the velocity will be very slow; but as the lever is rotated through an angle of 90 degrees, it gradually increases until it reaches the maximum. Upon the wooden base, and underneath the armature, is a switch, by which the whole motor is cut in or out of circuit. These small machines are complete in themselves, and require no auxiliary attachment for regulation. The commutators are made of cast steel, and are calculated to last for years. The journals are self lubricating, and will run for weeks without attention.

This type of motor is made in three sizes, namely: $\frac{1}{16}$, $\frac{1}{12}$, and $\frac{1}{8}$ horse-power. The same patterns are used in all, the difference in capacity being effected by winding more or less wire on the field. Their efficiency ranges from about 70 per cent. for the $\frac{1}{16}$ to 65 per cent. for the $\frac{1}{8}$ horse-power. This efficiency might be considered very low for large motors, but for motors of this size shows good design.

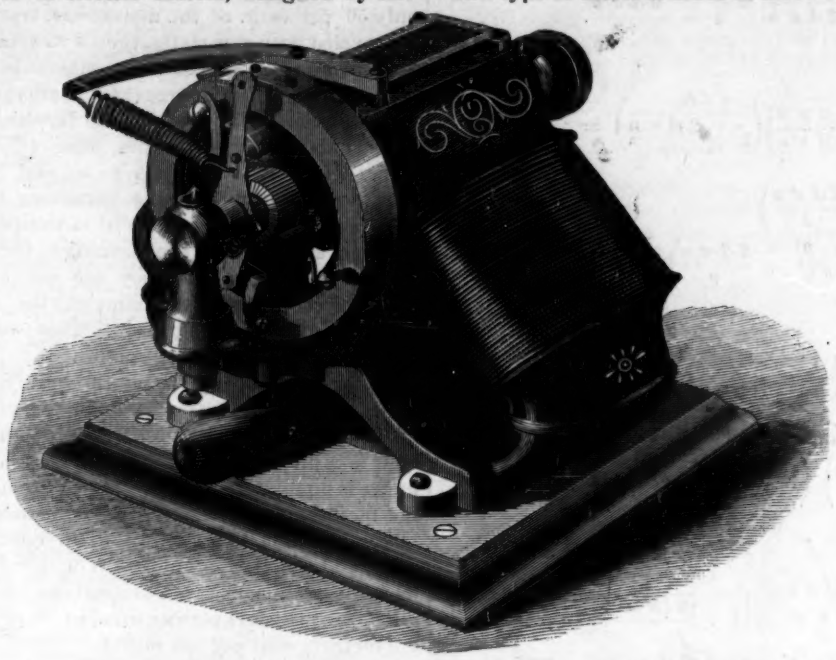


FIG. 1.—SMALL BAXTER MOTOR FOR ARC CIRCUITS.

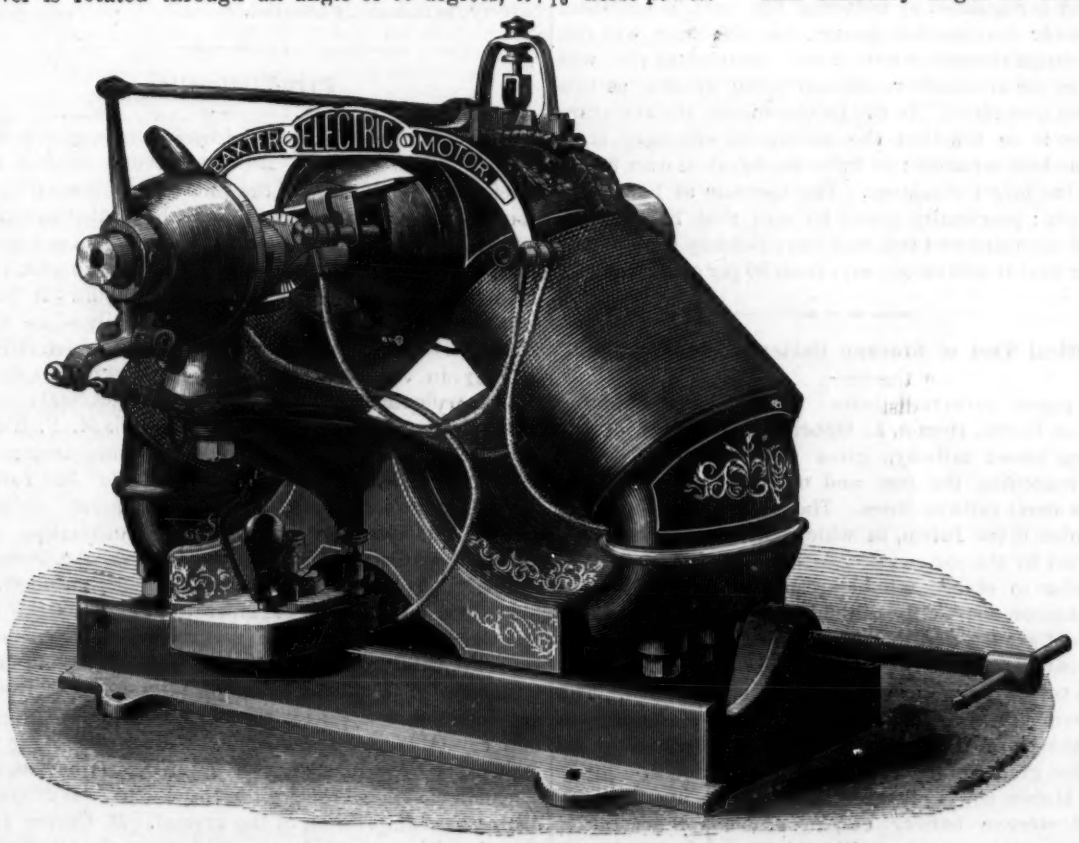


FIG. 2.—LARGE BAXTER MOTOR FOR ARC CIRCUITS.

Figs. 2 and 3 show the general appearance of the larger sizes of the Baxter motors. Fig. 2 is a constant current, and Fig. 3 a constant potential motor. There is no difference in design between the two, but the method of regulation differs in each.

The constant potential machine is wound so as to run at a constant speed, but as the same principle cannot be applied with a constant current without too great a loss in efficiency, a mechanical governing arrangement is used in the latter type. This is illustrated in Fig. 2. The governor proper is carried on the outer end of the shaft, and is located within the shield shown in front of the motor. The device by which the action of the governor is made to regulate the speed is located on top of the pole plate. The principle of regulation consists in changing the magnetic intensity of the field by a variation of the ampère turns in the magnet coils.

With this system of regulation, down to a certain limit the efficiency rises; below that it begins to decrease until it becomes the same as at maximum load. Practice shows that the highest efficiency is between one-half and two-thirds the full capacity, and that at one-third and full load it is about the same. On this account this type of motor is well adapted to a system of distribution of electrical energy from a central station.

The resistances of a 10 horse-power motor for a 10-ampère current are as follows: Armature, .75 ohm; field, 3.75 ohms; total internal resistance, about 4.5 ohms; difference of potential without load, 45 volts; total difference of potential of motor when developing 10 h. p., about 792 volts; loss by internal resistance, .0567, or a little more than 5¼ per cent.

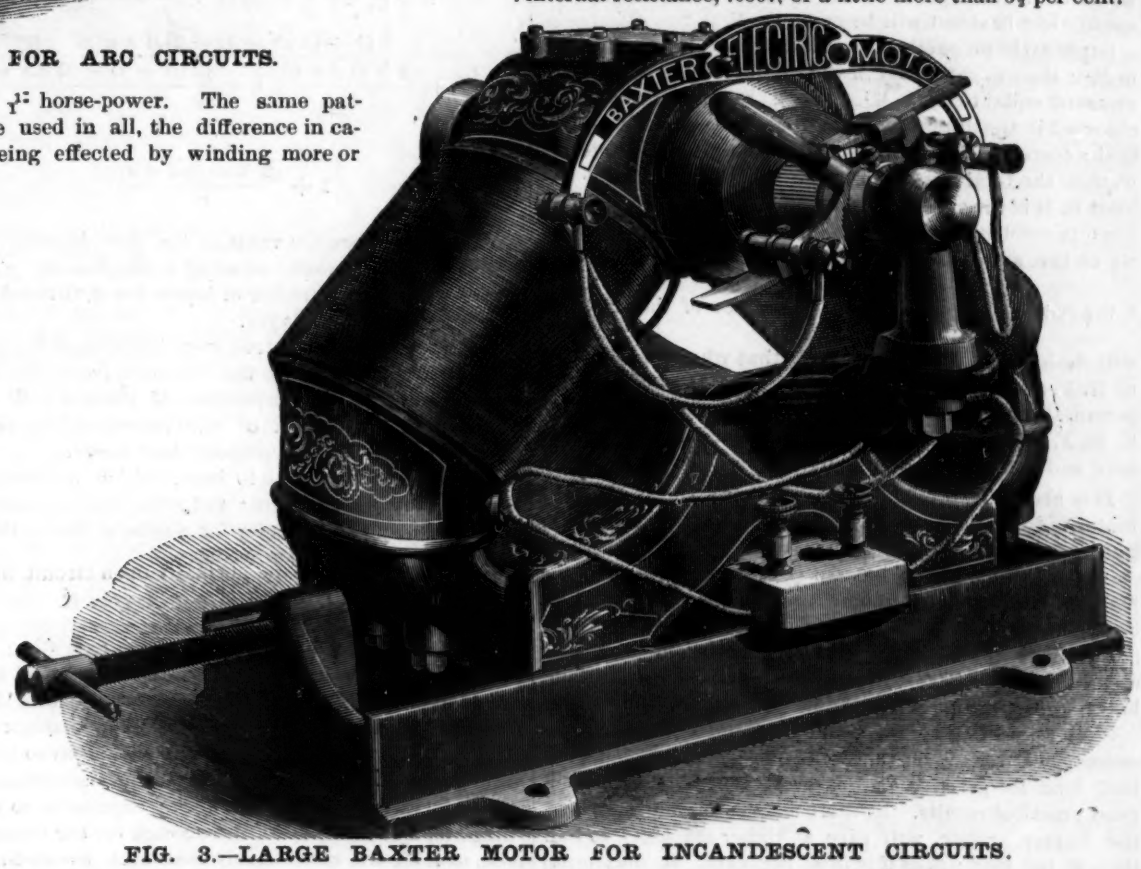


FIG. 3.—LARGE BAXTER MOTOR FOR INCANDESCENT CIRCUITS.

There are two layers of wire on the armature, the number of turns being 320; as this sets up a counter E. M. F. of about 750 volts, it is at the rate of 2.28 volts per turn. Reducing this to work, it means an output of more than 1,000 foot-pounds per turn, or nearly 300 foot-pounds per foot of wire.

The weight of wire on the armature is about 12 pounds; weight of iron, about 75 pounds; weight of wire on field, about 160 pounds; iron in field, 1,100 pounds.

These figures show that a very small amount of wire is used, but that otherwise the machines are very massive. On this account the reaction of armature on the field is practically nothing, and therefore the brushes require no lead; hence the load may be varied at will without causing sparking, as the diameter of commutation remains unchanged.

The Baxter constant potential motor is almost identical in appearance with the constant current machine just described. The regulation is accomplished by the method of winding; hence the governor and its attachments are removed, the switch is also replaced by simple binding posts, as these motors are provided with an independent automatic cut out and hand switch combined. Constant speed is obtained by a simple shunt winding.

From an electric standpoint Mr. Baxter considers the constant current method of distribution to be the better. This superiority, he states, is not due to any defects in the constant potential motor, but is owing to the fact that there are certain advantages in the constant current system, in virtue of which it is possible to obtain results that are beyond the reach of the constant potential system, no matter on what principle the motor may be constructed.

According to Mr. Baxter, if a motor is supplied with current at a constant potential the loss of energy in the field will be constant whether the work done is a maximum or zero, that is, if the field is in shunt; for the resistance R will be constant and also the difference of potential E constant. Therefore, $\frac{E}{R} = c$ will be constant, and hence $c^2R = W$ will be constant. The loss of energy in the armature

circuit will decrease as the work decreases, inasmuch as $E = e + Cr$; whence $CE = Ce + c^2r$, therefore as Ce measures the work, and $e = E - Cr$, it follows that a variation in work causes a variation in C, hence in C^2r. Therefore the loss of energy in the motor is composed of the two quantities W and C^2r, the first constant, the second variable. In any well-proportioned machine W constitutes the bulk of the loss. If we assume it to be $\frac{1}{4}$ there is but $\frac{1}{4}$ of the loss that is a variable quantity, supposing the variation to be directly as the power, which is very nearly right.

The loss at half capacity would be $\frac{1}{4} + \frac{\frac{1}{4}}{2} = \frac{3}{8}$. If the efficiency at full load is 90 per cent., at half load it would be 87½ per cent.

If, according to Mr. Baxter, the field is wound differentially, the loss of efficiency will not increase so rapidly, but the initial efficiency will be less, so that the results obtained at any rate of working will not be as good. To prove this, let the current energy in shunt C^2R produce a field M. Let the turns of wire on armature be N; then the potential E will develop a velocity $V r M N V = E$. That is the armature with N turns, rotating in a field M at a velocity V will set up a counter E. M. F. which, added to the E. M. F. necessary to overcome the armature resistance, will balance E. It makes no difference how M is produced, whether by shunt or differential winding, or by a current supplied from an independent source. If it is produced by differential winding, the energy lost in shunt will be greater.

Suppose the magnetic moment due to the differential coils is M^1; then to get a field M the shunt coils must develop a moment equal to $M + M^1$. Let T represent the energy absorbed in the differential coil to produce M^1 and assume that a corresponding amount in the shunt will counteract it, then the total loss of energy in field will be $C^2R + 2T$. That is, it is the amount lost when the shunt alone is used, plus twice the loss in the differential coils; and the velocity of the armature will be less because we have $E = e + cr + \frac{T}{c}$. Consequently the reaction of the armature will be less, as it must be such that when added to the E. M. F. absorbed by its resistance and the difference of potential of the differential coils, it will balance the E. M. F. of the circuit; therefore, more current will be used and less work done.

The above reasoning is on the supposition that the motor is doing no work, but, according to Mr. Baxter, will hold good when any amount of work is done; but under such conditions, as the current in armature increases, the E. M. F. required to overcome the armature and differential coil resistance will increase, and therefore e will decrease, and consequently also V. But if the armature circuit resistance is very low, a very small change in V will make a great difference in the power.

Close regulation cannot be obtained unless the armature resistance is very low; therefore, the loss in efficiency at half load as given above is fully within the limits of good practical results. Now a constant current motor of the Baxter system will give a higher efficiency at half than at full load; thus if it is 90 per cent. at maximum capacity, it will be something more than this at one-half. Supposing it to be 91 per cent., then if the average work of a system of motors supplied with current from a central station is 50 per cent. of their rated capacity, the constant system will supply $\frac{91}{82\frac{1}{2}}$, that is, 1.10, or ten per cent. more power. As the average output in practice is nearer one-third than one-half, the real difference will be more than stated above; in fact it will be somewhere around 14 or 15 per cent.

In order to show that the efficiency of his constant current motor increases with a reduction in the work done, Mr. Baxter reasons as follows:

In a series wound constant current motor running at a constant velocity the work done is proportional to a constant, plus the magnetic moment of the field. The constant represents the rotative moment of the armature when no current traverses the field coils, and the magnetic moment is that due to residual magnetism only. This constant practically amounts to quite a considerable amount, being enough to overcome all frictional resistance, and in addition do from 4 to 10 per cent. of the total work put forth by the motor. Therefore, it is enough to balance the constant loss of energy due to the armature resistance, so that all we need to prove is that the field loss will decrease as fast as the power, if not faster.

Let D represent the diameter of magnet core; d, diameter of wire. Then the length of a turn on first layer will be $(D + d)\ \pi$; on the second, $(D + 3\ d)\ \pi$; on the third, $(D + 5\ d)\ \pi$, etc. The difference in length or resistance between a turn on any two consecutive layers is, therefore, $2\ d\ \pi$. If R represents the total resistance of the coil, N the number of layers, then the resistance in each layer will be as in the following series: $r + (r + 2\ d\ \pi\ n) + (r + 4\ d\ \pi\ n) + (r + 6\ d\ \pi\ n) +$, etc., $(r + (2\ N - 2)\ d\ \pi\ n) = R$; where r is the resistance of the first layer, and n the number of turns in a layer. As the magnetizing capacity of the wire is proportional to the turns and not the length, for equal resistance, its value in the various layers will be inversely proportional to their length.

Placing the value of layer No. 1 equal to S, that of the others will be

No. 2.

$$\frac{r\ S}{r + 2\ d\ \pi\ n} = \frac{S}{1 + \frac{2\ d\ \pi\ n}{r}}.$$

No. 3.

$$\left(\frac{r + 2\ d\ \pi\ n}{r + 4\ d\ \pi\ n}\right)\left(\frac{S}{1 + \frac{2\ d\ \pi\ n}{r}}\right) =$$

$$\frac{\left(1 + \frac{2\ d\ \pi\ n}{r}\right) S}{\left(1 + \frac{4\ d\ \pi\ n}{r}\right)\left(1 + \frac{2\ d\ \pi\ n}{r}\right)} = \frac{S}{1 + \frac{4\ d\ \pi\ n}{r}}.$$

No. 4.

$$\left(\frac{r + 4\ d\ \pi\ n}{r + 6\ d\ \pi\ n}\right)\left(\frac{S}{1 + \frac{4\ d\ \pi\ n}{r}}\right) =$$

$$\frac{(1 + 4\ d\ \pi\ n)\ S}{\left(1 + \frac{6\ d\ \pi\ n}{r}\right)\left(1 + \frac{4\ d\ \pi\ n}{r}\right)} = \frac{S}{1 + \frac{6\ d\ \pi\ n}{r}}.$$

No. N.

$$\left(\frac{r + (2\ (N-1) - 2)\ d\ \pi\ n}{r + (2\ N - 2)\ d\ \pi\ n}\right)\left(\frac{S}{1 + \frac{[2\ (N-1) - 2]\ d\ \pi\ n}{r}}\right) =$$

$$\frac{(1 + [2\ (N-1) - 2]\ d\ \pi\ n)\ S}{\left(1 + \frac{(2\ N\ 2)\ d\ \pi\ n}{r}\right)\left(1 + \frac{[2\ (N-1) - 2]\ d\ \pi\ n}{r}\right)} =$$

$$\frac{S}{1 + \frac{(2\ N - 2)\ d\ \pi\ n}{r}}.$$

That is, they are the value of the first layer divided by unity, plus the diameter of wire, multiplied by π, multiplied by twice the number of layers less 2, divided by the resistance of the first layer.

These ratios would be true were it not that the magnetizing effect decreases as the distance from the core increases, and that the temperature of the coil and magnet increases as the amount of wire increases; hence terms must be introduced to represent these losses.

Let t represent loss due to heat, which is directly proportional to length of wire; and v the loss in magnetizing effect; and substitute unity for S so as to reduce the ratios to unity resistance; then we have—

$$\frac{1}{1 + \frac{A d\ \pi\ n}{r}} - (v + A'\ t) = M$$

as a general expression for the magnetizing effect of unity resistance of wire. Now the magnetism of field does not increase in direct proportion to the magnetizing capacity of wire, owing to the fact that there is a limit to the magnetic force of an iron core. Therefore a saturation term should be introduced in the above expression to make it complete. But as it stands, it is enough for the present purpose, as it shows conclusively that each succeeding turn of wire wound on a magnet produces a less effect than the preceding one, or in other words, it takes more than double the length of wire to double the strength of field. Hence if a motor is regulated by reducing the field magnetism, as the power developed decreases, the efficiency will rise and the range through which it will continue to rise will depend on the armature resistance being greater as this resistance is reduced. In the Baxter motor, the armature resistance is so low that the maximum efficiency is at about one-half capacity; at full capacity it is over 90 per cent. in the larger machines. The increase at half is not very much; practically it may be said that between the limits of one-third and full load the efficiency is about the same, or that it will range, say, from 90 per cent. to 92 per cent.

A Practical Test of Storage Batteries on Street Cars.

In a paper just read before the Elektrotechnischer Verein, at Berlin, Herr J. L. Huber, the engineer of the Hamburg street railway, gives some very interesting details regarding the cost and operation of storage batteries on street railway lines. The system employed by Herr Huber is the Julien, in which the storage batteries are carried by the car.

In order to obtain reliable results, experiments were undertaken on a specially difficult line, both as regards curves and grades, and which, in addition, crossed much-frequented streets, so that all the difficulties met with in railroad traffic in populous cities were encountered. The road extends from the Rathhausmarkt, in Hamburg, to the Berthastrasse, Barmbeck, over the Mühlendamm, on which line grades of 30 per cent. are encountered.

Herr Huber states, regarding the durability of the E. P. S. storage battery employed, that deterioration takes place only in the positive plates; and this is the more pronounced the greater and more frequent the normal strength of current for which the plates are designed is exceeded. With a well-regulated management, that is, by an arrangement of storage batteries and car, such that with the heaviest grades and loads no abnormal current is drawn from the battery, the wearing out of the positive plates amounts to from 2 to 3 per cent., or, in round numbers, 2½ per cent. for 1,000 kilometres traveled. If, in addition, the traffic be so arranged that with every charge of the accumulators only 50 per cent. of the distance is traveled which could be traveled with new plates, then a wearing out of the plates amounting to 50 per cent. is permissible; that is to say, that over 20,000 kilometres (12,500 miles) can be run before renewal becomes necessary. A car which, including passengers and storage batteries, weighs 7,000 kilogrammes (about 7 tons), and which is to ascend grades of 30 per cent., such as occur on the Hamburg line, requires 800 kilogrammes of active material in the positive plates, and its renewal, including the cleaning of the grids, which can be used over again as they are not oxidizable, costs 1 mark (25 cents) per kilogramme (2.2 lbs.); that is, 4 pfennigs (1 cent) per kilometre run. That would be 1⅜ cents per car mile for renewal of plates.

Under the same conditions the motive power required is ¼ horse-power hour per kilometre (¼ mile) run. The cost for attendance, oil, maintenance, etc., for one horse-power hour is 8 pfennigs; consequently this cost per car kilometre is 6 pfennigs. To the above items must be added the maintenance, oil, etc., for the motor on the cars, which amounts to 2 pfennigs, and contingencies run up to an additional 2 pfennigs. The total cost, therefore, with the conditions given amounts to 14 pfennigs per car kilometre (5⅜ cents per car mile) or 2 pfennigs per tonne kilometre (¼ cent per ton mile.)

Comparing the cost of electrical traffic with that of horses, Herr Huber states that to operate the usual one-horse car, which, including driver and conductor, carries 26 persons, 7 horses are required on the same line for one day of 100 kilometres run. So that, as the electric car carries 31 persons, $8\frac{35}{100}$ horses would be necessary. The cost of maintenance for one horse during the last year, according to the Jahresbericht der Strassen-Eisenbahn-Gesellschaft, Hamburg, amounted to 1.96 marks (49 cents) per day per horse; so that the cost per car kilometre amounts to 16.04 pfennigs (6⅜ cents per car mile). It follows, therefore, that even to-day electricity is more economical than horse-flesh, and the cost of the former can be considerably reduced by improvements.

The results of experiments show that 88 per cent. of the energy stored in the accumulators can be drawn out, and Herr Huber only counts upon 80 per cent. for safety; that is to say, that of the electrical energy delivered by the dynamos, 20 per cent. is lost by the use of accumulators, and this is independent of the length of the line and the power required upon the same, such as the overcoming of grades, etc. It is to be remarked also, that for the electric traffic such as exists in Hamburg, any car driver can be employed and no trained men are necessary, as is the case with locomotives, so that the expense of trained hands is avoided.

The above are the results of experiments which were carried out from the end of May to the end of December of last year, with a public passenger car, and the distance traveled amounted to 12,000 kilometres (about 7,500 miles). As these experiments were undertaken in public traffic on an ordinary horse road made specially difficult by its grades, and not upon a road specially constructed for the purpose, it follows, as Herr Huber states, that the life and power of competition with other systems, of the storage battery, is definitely assured.

Pyro-Electricity.

At a meeting of the French Physical Society, reports the London *Electrician*, M. Duhem recently opened a discussion on the question of the connection between the phenomena of thermo-electricity and the electrification of a tourmaline plate when heated, which is known as pyro-electricity. According to an old theory of Gaugain, the coordination of the phenomena is not difficult. A plate of tourmaline, cut normal to the axis, exhibits when heated opposite electrification upon its two poles (which differ externally in the form of their faces), while the signs of the electrification change places when the crystal is cooled. Now, if the existence of this internal E. M. F. is due to a cause similar to that which determines thermo-electric E. M. F., two conditions should be fulfilled. (1) A difference of temperature must exist between different portions of the tourmaline plate. (2) The structure of the plate must be heterogeneous. Both these conditions are evidently fulfilled.

There is a difference of temperature between the inside and the outside of the plate, and the crystalline condition provides the required heterogeneity in the molecular structure. The phenomenon of piezo-electricity (or the development of the electric condition by subjecting certain crystals to compression) may also, according to M. Duhem, be brought under the same denomination, if we consider the effects to be primarily due to heat disengaged during the compression of the crystal. M. Currie agreed that the phenomena of pyro and piezo electricity had a common origin, namely, the deformation of the crystal. But he could not admit that they were identical, or that the latter was due to the development of heat by compression. The amount of heat so developed was far too small to account for the observed degree of electrification.

Induction Coils Graphically Treated.*

BY GISBERT KAPP.

An impression is prevalent amongst practical electricians that the investigation of alternating currents, of their production by dynamo machines, and of their utilization in transformers or induction coils, is a matter of extreme difficulty, requiring complicated mathematical formulæ, if we wish to reduce the working conditions of a given set of apparatus, and the results obtainable with it, to actual figures. We find in text books, and in articles which have appeared in scientific publications, elaborate mathematical expressions which are well calculated to justify the impression above alluded to, not only on account of their inherent complexity, but also because, being evolved on strictly scientific principles, and from laboratory experiments, the connecting links with actual practice on a large scale are often left obscure or entirely neglected. As a general rule, practical electricians have neither sufficient knowledge of higher mathematics, nor the necessary leisure to establish these connecting links for themselves; in other words, to fish out from a mass of theory that which is of real practical importance, and to apply it to the actual design of apparatus; these long and elaborate mathematical investigations are, therefore, of very little use to them. If it were possible to emancipate ourselves from theory altogether, and investigate the subject simply by experiments carried out on a large scale in the workshop, the results obtained would, no doubt, be more readily applicable to practical work than abstruse formulæ; but on the other hand, it would not be safe to generalize from such results. Experimental investigation of many mechanical problems, such as the lever, the screw, blocks and falls, etc., would by itself entirely suffice to obtain by generalization a good working theory of these appliances; but, in other cases, where the time element is of influence, our senses are insufficient to grasp the whole of the phenomena involved in the experiment, and, under these conditions, the attempt to generalize from experiments only must lead to erroneous results. Take, as an example, the case of an alternate current dynamo, working on a circuit which has considerable self induction. A person having no theoretical acquaintance with the behavior of alternating currents, would compute the rate of doing work in the circuit by simply measuring the current (say with a Siemens dynamometer), and the terminal pressure of the machine (say with a Cardew's voltmeter), and multiply the two. The product he would, generalizing from his experience with continuous current machines, consider equal to the rate of doing work. But this would be completely wrong,

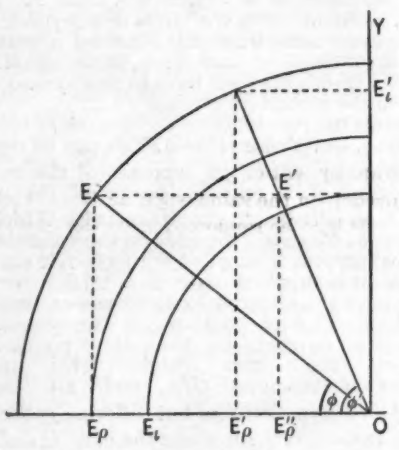


FIG. 1.

because he would have neglected the time element, which cannot be grasped by his senses. It can, however, be very easily brought within the domain of calculation and measurement; but, in order to do so, we must perform a theoretical investigation. Our theory, to be of easy application, should not only be as simple as possible in itself, but, what is even more important, it should take as a starting point some conception already familiar to the practical electrician, and it should give the final result in a shape and in terms also familiar to him.

In the following the conceptions of magnetic lines of force, and magnetic resistance, both of which in the case of the continuous current dynamo have been generally accepted as the basis of its theory, are taken as the starting point. The text book method of investigating alternating currents is to begin with the assumption of a certain impressed E. M. F., then to introduce certain co-efficients of self and mutual induction, and to establish for the resultant currents certain differential equations which, in some special cases, are capable of a fairly easy solution. If desired, the resultant magnetization of the core can be found, as a last operation. In the present investigation, we shall reverse this order. We assume a certain magnetization of the core, and proceed backwards, so as to obtain the impressed E. M. F. as a final result by a graphic method. After the graphic method has thus been fixed, it will serve also in those cases where the impressed E. M. F. is given and the other quantities are required to be determined. Before entering on the investigation, it is, however, necessary, to make an assumption regarding the function according to which the impressed E. M. F. varies with time. It is customary to assume that the E. M. F. is a harmonic function, such, for instance, as would obtain in a coil revolving round an axis in its own plane with uniform angular speed in a uniform magnetic field. If A be the area of the coil, m the induction (number of lines per square centimeter of field), and ω the angular velocity; and if we count the time t from the moment that the plane of the coil is vertical to the lines of the field, we find the number of lines threading through the coil at an angular position $\alpha = \omega t$.

$$Z = m A \cos \alpha.$$

The E. M. F. at that instant equals the rate of cutting lines at that instant, viz.,

$$e = -\frac{dZ}{dt}$$

and if we call T the time required for one revolution, and note that $\omega = \frac{2\pi}{T}$ we find the impressed E. M. F. in absolute units,

$$e = \frac{2\pi}{T} m A \sin \alpha.$$

This will be a maximum when $\alpha = 90°$, that is, when the plane of the coil is parallel to the lines of force. Let E be this maximum, then

$$e = E \sin \alpha$$

where $\sin \alpha = 2\pi \frac{t}{T}$ and $E = \frac{2\pi}{T}$ times the greatest number of lines which can pass through the coil. To obtain e in volts, we must express E in volts, viz.,

$$E = \frac{2\pi}{T} Z \times 10^{-8}$$

where $Z = m A$, the full number of working lines.

A familiar mechanical illustration of a harmonic motion is the apparently oscillatory motion of a crank pin, as seen end on. Suppose we look down on the crank of a well pump, then (neglecting the influence of the finite length of connecting rod) the position of the pin on the right or left of the centre line is a proportional measure for the speed of the piston at any instant. In other words, the horizontal projection of the crank radius will graphically represent the speed of the piston if the scale of the diagram is so chosen that the length of radius represents maximum speed. This method of representing varying

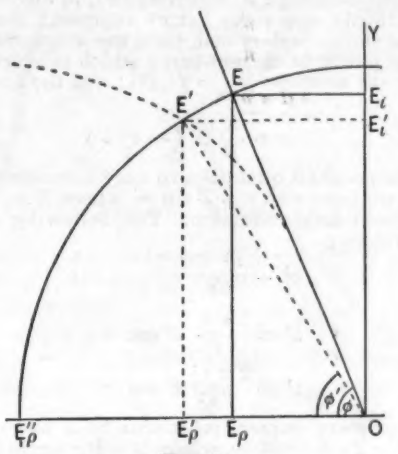


FIG. 2.

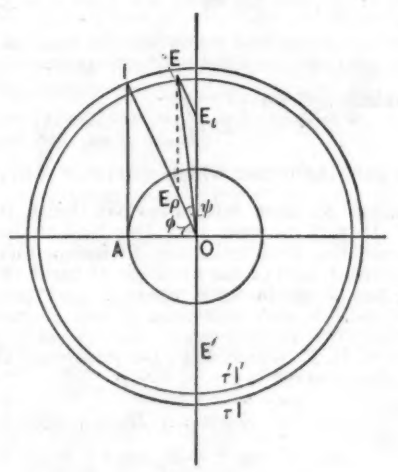


FIG. 3.

quantities by the projection of lines revolving round a centre, is the basis of our graphic theory of transformers. It must be pointed out that the method can only give correct results if the quantities vary according to a true harmonic law, and the question naturally arises whether this is the case with the impressed E. M. F. in dynamo machines as actually constructed. As a general rule, it may be safely assumed that this will not be strictly the case. The impressed E. M. F., especially in machines containing iron in the armature, will vary according to a much more compli-

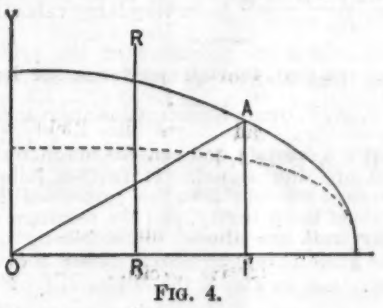


FIG. 4.

cated law, and, perhaps, one which cannot even be expressed as a continuous mathematical function; but the deviation from a true sine function has, in the few cases which have been experimentally investigated by Dr. Hopkinson and others, been found to be comparatively slight, and hence we shall not commit a very great error if we assume the sine function to hold good in practice. Another, and in itself sufficient reason for this assumption, is that the greater accuracy which might, perhaps, be obtained by taking a different function as basis of the investigation, would be accompanied by such complications as to render its easy and practical application impossible. Where the difference between the actual and the assumed function is great, a correction might be applied in the shape of a coefficient which could be found by experiment. In the following, it is, therefore, assumed that the E. M. F., acting upon the terminals of either a single coil having self induction, or upon those of the primary of a pair of coils having self and mutual induction, is a simple harmonic function of the form.

$$e = E \sin 2\pi \frac{t}{T}$$

where E is the maximum E. M. F. occurring at the times $t = \frac{1}{4} T$, $t = \frac{3}{4} T$, etc.; and T is the time of a complete phase, consisting of two reversals. It is further assumed that the coils contain an iron core forming part of a completely closed magnetic circuit, so that the electric and magnetic circuits are relatively to each other in a position which might be familiarly described as that of two neighboring links in a chain; and that no leakage of lines of force takes place outside the core. The latter assumption is of special importance, because it is only under this condition that the same number of lines of force are cut at each reversal by every turn of the coils, and that the induced E. M. F. of each coil may be considered proportional to the total induction and the respective number of turns.

As regards the first assumption, viz., that of the threading of one circuit through the other, it may be as well to point out in this place that the exact manner in which the circuits are arranged is, on purely theoretical grounds, of no importance, so long as in different arrangements the total magnetic flow through the core, and the total current turns through the coils, are the same. From a practical and commercial point of view, however, that arrangement will evidently be the best in which both the path of the lines and the length of wire in the coils are reduced to a minimum. Thus a ring-shaped inductor wound in the Gramme fashion, that is, with the iron inside and the copper outside, will not be as economical in weight of materials used as the inverse arrangement of copper coils inside, and iron wire wound over them to form the outside. In the following we shall, however, not limit the investigation to any one special arrangement, but simply assume that the conditions mentioned above are fulfilled. It is evident that the phases of induced E. M. F.'s and currents must all be equal to, though not coincident with, that of the impressed E. M. F., and each of these quantities can be represented by a similar function to that given above, viz., as the product of a maximum value, and the sine of an angle.

1. *Single Coil.*—If the greatest induction in the core remains within the limit for which direct proportionality between exciting power and total induction can be assumed, the induced E. M. F. remains proportional to the current. Let $i = I \sin \alpha$ and $z = Z \sin \alpha$ represent respectively the current and total induction (total flow of lines), I and Z being maximum values, and $\alpha = \frac{2\pi t}{T}$. In establishing these equations, it is assumed that the actual

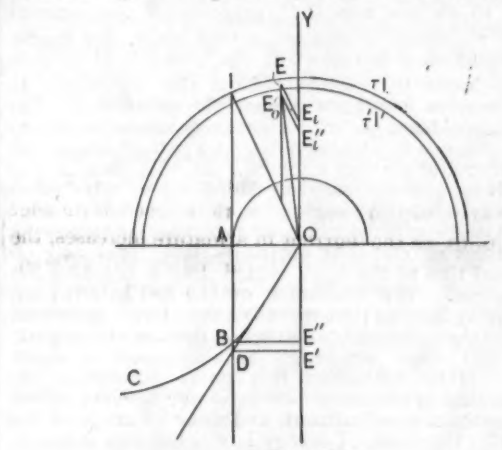


FIG. 5.

magnetization is, in phase, coincident with the magnetizing current (exciting power), and that there is no difference between an ascending and descending magnetization. The first assumption is probably correct, while the latter is not; but, by sub-division of the iron core, the error can be somewhat reduced. It should also be noted that another error, due to saturation, tends to compensate for the neglecting of hysteresis, and for the sake of simplicity, both these errors are assumed to be unimportant, and are neglected. If the coil consist of r turns of total resistance r, the induced E. M. F. at any moment is $r \frac{dz}{dt}$, and the E. M. F. required to overcome the resistance is $r\,i$. Writing e_ι and e_ρ for these quantities, and E_ι and E_ρ for their maxima, we find the impressed E. M. F. e by adding e_ι and e_ρ.

$$e = E_\iota \cos \alpha + E_\rho \sin \alpha;$$

and since this must evidently be a sine function, we can write $e = E \sin(\alpha + \varphi)$; where φ is a certain angle smaller than $\frac{\pi}{2}$.

The value of φ is found from the consideration that for $\alpha = 0$, $e = E \sin \varphi$; and for $\alpha = \frac{\pi}{2}$, $e = E \cos \varphi$;

$$\tan \varphi = \frac{E_\iota}{E_\rho};$$

$$E_\iota = \frac{2\pi}{T} r Z;\ E_\rho = r I;\ Z = f(I).$$

For low degrees of magnetization, the function of I, which gives the total induction Z, takes the form of a constant factor depending on the quality of the iron, and the configuration of the core. It can, with sufficient accuracy for practical purposes, be represented by

$$\mu \frac{4\pi r I}{\frac{l}{a}},$$

where μ is a co efficient varying with the quality of the iron, l is the mean length of the path of the lines, and a the cross section of the core, which we assume to be uniform. Writing R for $\frac{l}{a}$ and K for $\mu 4\pi$, we have

$$Z = K \frac{r I}{R}.$$

In this expression, R represents the magnetic resistance, and the influence of higher degrees of magnetization can be taken into account by mutiplying $\frac{l}{a}$ with a factor depending on the degree of magnetization. This factor can

*Industries.

either be obtained from curves of magnetization such as given by Dr. Hopkinson in his paper on the "Magnetization of Iron,"* or by the adoption of an empirical formula. From experiments on dynamo machines, I have found the factor $\tan\left(\frac{\pi\sigma}{2}\right) : \frac{\pi\sigma}{2}$ (where σ is the ratio of actual induction to the possible maximum induction) to give fairly satisfactory results.

A. *Disregarding the Saturation Term.*—The formula for the impressed E. M F. is capable of graphic representation. Starting with a given maximum current I, we find the corresponding total induction and the values E_l and E_ρ, by calculation, the resistance of the coil, number of turns and configuration of the core being supposed to be given. In the diagram (Fig. 1) $O\,E$ the maximum impressed E. M. F., and the lag φ are found graphically from the known values of E_l and E_ρ by constructing the triangle $O\,E_\rho\,E$. The current at any moment is proportioned to the projection of either $O\,E_l$ or $O\,E_\rho$ on the vertical $O\,Y$, and the impressed E. M. F. is proportioned to the corresponding projection of $O\,E$ on the vertical; both these quantities can, by suitably choosing the scale, be read directly off the diagram. The variations in the impressed E. M. F., and in the resultant crrrent strength are thus represented by the variations which the projections of the two lines $O\,E$ and $O\,E_\rho$ undergo while these lines are revolving round the cen tre O, the former being always in advance by the angle φ. In other words, the current lags behind the impressed E. M. F. by an interval of time represented by this angle. It is evident that the lag is independent of the impressed E. M. F., but increases if the resistance is decreased. Assume now that the condition of the apparatus represented by the diagram is well within the limits for which direct proportionality between magnetizing force and total induction can be assumed, then an inincrease or decrease in E. M. F. will produce a corresponding increase or decrease of E_l, E_ρ, and I, without alteration in the angle of lag. If the resistance r be diminished, the current will increase, and *vice versa*. This can be easily seen from the diagram. Let $O\,E''_\rho / O\,E_\rho$ represent the ratio in which the resistance has been diminished, and assume for a moment that the current has not altered. This could be attained by a suitable reduction of impressed E. M. F. from $O\,E$ to $O\,E'$. The new angle of lag is now φ'. But if the impressed E. M. F. has not been reduced, all the quantities must be increased in the ratio of $O\,E/O\,E'$, and we find $O\,E'_l$ and $O\,E'_\rho$ as the true values of E. M. F's due respectively to induction and resistance. If the scale for the current has been so chosen that $O\,E_l$ represented the current before the reduction in resistance took place, the length $O\,E'_l$ gives at once the new current, and it will be seen that even were it possible reduce the resistance to zero, the current could not exceed the value $O\,E$. The case here considered is of importance when arranging arc or glow lamps in parallel between a pair of mains fed from an alternate current machine. In this case, a coil having self induction (termed by Mr. Gordon, who originated this system, a "choking coil"), is placed in each lamp circuit. The resistance r consists, then, of two parts; of the lamp, which we may regard as free from self induction, and that of the coil, which has a considerable self induction. The resistance of the coil is, however, comparatively low, so that there is a very large difference in the resistance of each branch when the lamp is properly burning, and when by design or accident, it is short-circuited. Notwithstanding this great difference, the current passing in the latter case need not be very much larger than the normal current, and since its angle of lag is nearly 90°, the waste of energy is only trifling. A simple calculation, which need not here be given, shows that if hysteresis be neglected, the waste of energy is only due to the resistance of the choking coil, which, of course, can be made very small.

B. *Taking the Saturation Term into Account.*—Only a slight modification of Fig. 1 is required to obtain an approximate solution of the problem in the case that the iron core of the coil is so small as to become saturated. In that diagram $O\,E$ is a line drawn under such an angle φ to the horizontal, that its projection on the vertical may be considered to graphically represent to a suitable scale the total induction, whilst its projection on the horizontal may similarly be considered to represent the magnetizing force. In fact, we may consider $O\,E$ to be that portion of the characteristic of magnetization which, on account of its proximity to the origin, is a straight line. In Fig. 2, this characteristic, shown dotted, is prolonged. If saturation did not intervene the current would to a suitable scale be represented by the length $E\,E_l$, and the E. M. F. of induction by the length $O\,E_l$, the angle of lag being φ. But since, on account of increased magnetic resistance with approaching saturation, the current does not produce the full induction, the E. M. F. of induction must be smaller than $O\,E_l$. If the magnetic resistance were constantly maintained at its increased value, the intersection E' of the circle representing the impressed E. M. F., with the characteristic, would give the point the projections of which represent, as before, current and induced E. M. F. On this supposition, the angle of lag would be φ', the current would be $E'\,E'_\rho$ (measured with the same scale as previously), and the induced E. M. F. would be $O\,E'_\rho$. The current now found is evidently larger than $E\,E_l$. But the magnetic resistance is not constant; it has its initial or minimum value at the moment when the induction and current pass through zero, and it has a maximum value when the induction and current are maxima. If we construct the diagram on the assumption of constant minimum magnetic resistance, we obtain the current $E\,E_l$, which is evidently too small, while the angle of lag is too large; if we assume constant maximum magnetic resistance, we obtain the current $E\,E'_l$, which is evidently too large, while the angle of lag φ' is too small. The true value lies somewhere between the points E and E', probably nearer the latter, because hysteresis, which has been neglected, must operate in the same direction as an increase of magnetic resistance, and is of greatest influence at those moments when the magnetic resistance is a minimum. As an approximation sufficient for most practical purposes, $E'\,E'_l$ can be taken as the true value of the current.

It will be seen that an increase of impressed E. M. F. as soon as the knee of the characteristic has been passed, results in a comparatively large increase of current. In other words, the choking power of the coils begins to break down after this point, and under increasing pressures, its action approaches that of a resistance without self-induction.

In the previous part, the question of a single coil having self induction was treated, and it was shown how, by a simple graphic construction, the resultant current and the lag can be found, if the impressed E. M. F. at the terminals, and the constructive data of the coil, are given. We must now extend the method to the case of

2. *Two Coils.*—Let the symbols previously used stand for the primary coil, and let $e^1\,i^1$ denote induced E. M. F. and current in the secondary, the maxima being E^1 and I^1. The resistance of the secondary circuit we denote by r^1; and if this circuit contain, besides the secondary coil, no other portion having self induction, the three quantities are simply related according to Ohm's law, $E^1 = I^1 r^1$.

(A) *Disregarding the Saturation Term.*—The current in the secondary coil exerts a magnetizing force upon the core, which, on the whole, is in opposition to that of the primary coil, although it need not, and, in fact can never be diametrically opposed. Let r^1 represent the number of turns in the secondary coil, then the magnetizing force or exciting power in current turns which produces induction, is at any moment $(r\,i = r^1\,i^1)$; and the total induction is

$$z = \frac{K}{R}(r\,i - r^1\,i^1).$$

Since we suppose all quantities to vary according to a sine function, we have also $z = Z \sin\alpha$, where Z is, as before, the maximum total induction. The following equations are self-evident:

$$e^1 = \frac{r^1\,dz}{dt}$$

$$e^1 = \frac{2\pi r}{T} Z\cos\alpha$$

$$i^1 = \frac{2\pi r^1}{T r^1} Z\cos\alpha$$

Since the primary current must also be a sine function, we have $i = I\sin(\alpha + \varphi)$, where φ is the angle denoting the lead of the primary current over magnetization. The lead of magnetization over the secondary current is $\frac{\pi}{2}$, as appears by comparing the equations for z and i^1. The secondary current reaches its maximum value I^1 for $\alpha = 0$, $\alpha = \pi$, etc.

$$i^1 = I^1\cos\alpha.$$

From the above equation, for z we obtain also

$$z\frac{R}{K} = r\,I\sin(\alpha+\varphi) - r^1\,I^1\cos\alpha.$$

Since for $\alpha = 0$, $z = 0$; we have $r\,I\sin\varphi = r^1\,I^1$, and since for $\alpha = \frac{\pi}{2}$, $z = Z$; we have $r\,I\cos\varphi = Z\frac{R}{K}$.

From these two equations we obtain the angle of lead φ of the primary current over the magnetization

$$\tan\varphi = \frac{r^1\,I^1}{Z\frac{R}{K}}$$

$Z\frac{R}{K}$ is the exciting power which produces Z lines. If the magnetization remains within certain limits, this ratio is constant. It will be seen that the lead of the primary current over the magnetization is independent of the primary current, and of the number of turns in the primary coil; but depends upon current and turns in the secondary coil. It also increases if the magnetic resistance of the core is decreased, say by employing more iron. The E. M. F. which must be impressed on the terminals of the primary is $e = e_l\,e + \rho$

$$e = \frac{2\pi r}{T} Z\cos\alpha + Ir(\alpha+\varphi)$$

$$e = E_l\cos\alpha + E_\rho\sin(\alpha+\varphi).$$

This can be represented as a simple sine function

$$e = \sin(\alpha+\varphi+\psi)$$

where ψ is an angle representing the lead of the impressed E. M. F. at the terminals of the primary coil over the primary current; and by reasoning analogous to that employed above, we find

$$\tan(\varphi+\psi) = \frac{E_l + E_\rho\sin\varphi}{E_\rho\cos\varphi}.$$

In well designed apparatus the resistance of the primary circuit is very small, and the E. M. F. required to overcome it is very small as compared to the induced E. M. F. Hence the ratio $\frac{E_l + E_\rho\sin\varphi}{E_\rho\cos\varphi}$ has a very large value, and would be infinetely great if the resistance of the primary were zero. It follows that, in such apparatus, the lead of the impressed E. M. F. over magnetization approaches $\frac{\pi}{2}$ as the resistance of the primary coil and the magnetic resistance of the core are diminished. It further follows that if these resistances are very low, the impressed E. M. F. at the terminals of the primary, and the resultant current in the secondary coil, are almost diametrically opposed in phase. The graphic representation of the above formulæ is very easy. Let, in Fig. 3, the radius $\overline{OA}$ of the inner circle represent the effective exciting power $Z\frac{R}{K}$; and that of the second circle the exciting power $r^1 I^1$ of the secondary coil alone, then the hypothenuse of the triangle constructed with these two quantities as catheti gives at once the exciting power $\overline{OI}$ of the primary: and since the numbers of turns r^1 and r are supposed to be known, the currents in the secondary and primary for a given total induction are easily found. The E. M. F. in the secondary is proportional to the induction Z. Its maximum value can be calculated by using the formula

$$E_1 = \frac{2\pi r^1}{T} Z;$$

and this can be graphically represented to a certain scale by the length of the line $\overline{OE^1}$. Imagine, now, the three lines: $\overline{OI}$ representing maximum current in the primary; $\overline{OA}$ representing maximum exciting power, and, therefore, implicitly also magnetic induction in the core; and $\overline{OE^1}$ representing the maximum induction E. M. F. in the secondary, revolving at uniform speed round the centre O, and let them always keep their angular distances; then the simultaneous projections of these lines give at any moment the intermediate values for primary current, induction and secondary E. M. F. By suitably altering the scale, the projection of $\overline{OE^1}$ can also be made to represent the current in the secondary coil. Let—to the scale chosen for representing E. M. F.'s—the line $\overline{OE_\rho}$ represent the E. M. F. required to overcome the resistance of the primary, and $\overline{OE_l}$ the induced E. M. F. in the primary, both referring to the maximum current I; then by drawing $\overline{E_l\,E}$ parallel and equal to $\overline{OE_\rho}$, we find the impressed E. M. F. on the terminals of the primary $\overline{OE}$, and the lead ψ of it over the current.

So far, then, we are able, from a knowledge of the configuration of the core (giving R), the quality of its iron (giving K), and the electrical data of the coils (giving number of turns and resistances), to determine the currents and E. M. F.'s corresponding to any assumed magnetic induction in the core. But this is not the way the problem is generally met with in practice. We do not find that the induction is given, and impressed E. M. F. or primary current is required to be found, but the opposite. As a general rule, the primary current (series transformer), or the impressed E. M. F. (parallel transformer), is given; and the only question of practical importance is, what E. M. F. and current can be obtained from the secondary coil. The diagram, Fig. 3, gives a complete solution to this question, if we enlarge or reduce it, so that the line $\overline{OI}$ or the line $\overline{OE}$ will, to the scales chosen, represent respectively the given primary current or impressed E. M. F.

It is evident that an alteration of current or impressed E. M. F. in the primary will produce proportional alterations in the other quantities (the angles φ and ψ, however, remaining unaltered), and we can, therefore, re-draw the diagram so as to suit the given primary current or impressed E. M. F.

The diagram gives implicitly, also, the resistance in the secondary. This is easily seen from the following consideration. The diagram was constructed on the assumption that the induction Z has a certain value corresponding to the exciting power $Z\frac{R}{K}$, which is graphically represented by the length of the radius $\overline{OA}$ of the inner circle. Then we assumed a certain exciting power of the secondary, and represented it by the middle circle, marked $r^1 I^1$. Now the assumption of Z carries with it implicitly the assumption of a certain E. M. F. E^1 in the secondary, while in fixing the circle representing $r^1 I^1$, we have at the same time, implicitly assumed a certain current I_1 in the secondary; and since these qualities must be related by Ohm's law, we have in reality also found a resistance in the secondary circuit.

Now assume the resistance of the secondary to be varied. To fix ideas, let it be increased. This can be represented in the diagram by either an increase of the radius $\overline{OA}$, or by a decrease of the exciting power of the secondary $\overline{AI}$, or by both alterations simultaneously. Which of these representations we select, depends on the conditions under which the apparatus is supplied with electric energy. If, for instance, it is supplied with a constant current, we must vary both the effective exciting power (and implicitly the E. M. F. and resistance in the secondary) and the secondary current, so that the point I should remain on the outer circle. This will give us a series of triangles OIA, and all having an equal length of hypothenuse, but differing catheti $\overline{AI}$ and $\overline{OA}$, which respectively represent the current and E. M. F. in the secondary. Corresponding values of these two quantities can now be plotted in a curve (Fig. 4), which is the characteristic of a series transformer, and which can be used in the same way as the characteristic of a dynamo. It is evident that this curve must be an ellipse, and might, by a suitable selection of scale, be a circle. By adding a scale of resistances $R\,R$, the current $\overline{OI^1}$ and E. M. F. $\overline{I^1 A}$ corresponding to any resistance r^1 can be read off the diagram, for which purpose it is only necessary to prolong Or^1 to its point of intersection A with the characteristic.

The characteristic of a series transformer thus obtained is very instructive. It shows at a glance what alterations take place in the E. M. F. and the current (this refers, of course, to their maxima, but their mean values are in a definite proportion thereto) in the secondary circuit if its resistance be varied, say, for instance, by switching lamps in or out. For very large values of resistance, the alteration of current is proportionately much greater than that of E. M. F., whilst for very low resistances the alteration of current is small compared to that of E. M. F. Thus, if only a few glow lamps are being fed in parallel from the secondary circuit, the switching out of these lamps will not materially increase the pressure in the circuit; but if a sufficient number of lamps be switched on, so as to fully utilize the energy of the transformer, making the product $I^1 E^1$ a maximum, then the pressure will fall considerably, and the lamps will become dim. On the other hand, we might burn a limited number of low resistance glow lamps in series, and by short circuiting one after another, the current would not be materially increased; but also in this case the energy converted would be much less than could be obtained with the given transformer if worked in a condition represented by the middle portion of the characteristic. It is interesting to note that, even if the secondary coil be completely short circuited, the current in it does not become very great. Roughly speaking, it is twice the current at which the transformer develops the maximum energy. For commercial reasons, it is evidently necessary to work transformers at or near the point of maximum output, and a glance at the curve will show that this class of apparatus (series transformer, with a core sufficiently large to avoid approach to saturation) can never be self-regulating if so used. It can only be made approximately self-regulating if used under conditions represented by either extremity of the characteristic; but as, under these conditions, the output is very small, this is not practicable from a commercial point of view. It will be shown presently that transformers with small cores in which saturation is reached, are in this respect slightly better, although not nearly so perfect, as parallel transformers.

If the condition of supply is constant impressed E. M. F.,

* Philosophical Trans. Royal Society, 1885.

the point E in Fig. 3 must always remain on a circle described with $\overline{OE}$ as radius. In this case, the process of finding the characteristic is slightly more elaborate, but presents no special difficulty. We assume different values for the current in the secondary, and keep the effective exciting power for the present constant. Thus the point I in Fig. 3 assumes different positions on the line $\overline{AI}$ and its prolongation. To each position corresponds a certain value of $\overline{OE_\rho}$, all the points $E\rho$ lying on a vertical line, whilst $\overline{OE_l}$ remains, by reason of constant total exciting power, evidently constant. The corresponding points E lie, therefore, on the lines $E_l E$, each of these lines being drawn parallel to the corresponding line $\overline{OI}$, and equal to the corresponding values of $\overline{OE_\rho}$. Since this alters the distance of E to O, it is necessary to make a correction in every case by increasing or diminishing all the quantities proportionately, so as to bring back the point E to the circle representing the constant impressed E. M. F. The effect of the correction will be to diminish the E. M. F. in the secondary for increasing currents; but if the resistance of the primary be very small, the quantity $\overline{OE_\rho}$ in the diagram must in each case also be very small, and the correction and consequent alteration of E. M. F. becomes trifling. Practically, the characteristic of a parallel transformer is, therefore, a straight and horizontal line, and such a transformer will be almost perfectly self-regulating for constant pressure.

(B) *Taking the Saturating Term into Account.*—The effect of saturation is to make the induced E. M. F.'s E^1 and E_l not strictly proportional to the effective exciting power, but rather smaller. The only alteration in diagram, Fig 3, will, therefore, be that the point E^1 will lie inside its former position, and the point E_l will also be shifted nearer to the centre. Let $O\,C$, in Fig. 5, represent the characteristic of magnetization, drawn to such a scale that the ordinates represent the induced E. M. F. in the secondary (which is evidently proportional to Z), then, by altering them in the ratio of r to r', these ordinates can also be made to represent the induced E. M. F. in the primary. If the increase of magnetic resistance did make itself felt equally throughout the whole period, the induced E. M. F. in the secondary corresponding to the exciting power $\overline{OA}$ would be represented by the line $\overline{OE''} = \overline{AB}$, instead of the line $\overline{OE'} = \overline{AD}$, as before; and the induced E. M. F. in the primary would be represented by the line $\overline{OE_l''}$, instead of $\overline{OE_l}$, the ratio OE_l''/OE_l being equal to OE''/OE'. The lead of impressed E. M. F. over the current in the primary (ψ in Fig 3) has, in consequence of these alterations been somewhat decreased, and the impressed E. M. F. $\overline{OE_\circ}$ in the primary is also smaller than it would be if it were permissible to neglect the saturation term. Since, however, the effect of saturation is not felt at and near the point where the magnetization of the core passed through zero, the true value of the E. M. F. in the secondary lies between the points E' and E'', and that of the impressed E. M. F. in the primary between the points E and $E_\circ$. Owing to hysteresis, the true values will be rather nearer E'' and $E_\circ$ respectively, and might, for practical purposes, be considered to coincide with these points.

It is interesting to investigate the influence of saturation on the characteristic of a transformer. If the supply be at constant E. M. F., we assume, as before, different positions of the point I on the line AI, and its prolongation; ascertain the corresponding positions of $E_\circ$, and correct for constant impressed E. M. F. Owing to the relatively greater value of E_ρ, the corrections will be rather larger than before; but, on the other hand, the influence of these corrections upon $\overline{OE''}$ will be relatively less, since the intersection of the line $\overline{AD}$ takes place with the curve at B at a more obtuse angle than with the straight line at D. On the whole, therefore, the introduction of the saturation term, while lowering the characteristic of a parallel transformer throughout, need not necessarily cause it to depart more from a straight and horizontal line. To work with a high degree of magnetic induction is, therefore, compatible with the attainment of a nearly constant E. M. F. in the secondary circuit. If the supply is on the series system, with a constant current, a construction analogous to that described above gives a characteristic considerably below that found previously near the origin, and coinciding with the previous curve at the more distant points. This curve is indicated by a dotted line in Fig. 4.

It will be seen that it contains a somewhat longer portion where the slope is only slight, and this indicates that the variation of E. M. F. in the secondary has been somewhat reduced by reason of saturation. A series transformer, with a small and over saturated core, might therefore be made to regulate within somewhat wider limits than one where the core is large; but the regulation can never be perfect, and the output obtainable with a given weight of copper must be less than in a transformer which has a core large enough not to become over saturated.

Working Metals by the Direct Application of the Electric Current.

The method of welding metals by electricity, devised by Prof. Elihu Thomson, which has already been described by us, consists in bringing the two parts in contact and passing a current through them sufficient to fuse the two ends together. The two metals to be joined, therefore, are connected respectively to the positive and negative poles of the source of electricity.

In a method of working metals by electricity devised by Nicholas De Benardos and Stanislas Olszewski, of St. Petersburg, Russia, and lately patented in this country, a voltaic arc is produced between the metals to be operated on and a conductor brought in proximity to the former; the conductor thus forming one pole, while the metal to be worked constitutes in itself the other pole. The only apparatus needed outside of the electrical generator is a holder for the conductor, the holder and the metal to be operated on being so arranged as to be movable relatively to each other, so as to bring the conductor opposite to any desired point on the metal.

The accompanying illustrations show two forms of apparatus designed by the inventors to carry out the process. That shown in Fig. 1 is a simple form of carbon holder. As will be seen, it consists of a non-conducting handle A, having in its rear end a socket and binding-screw electrically conected to the conducting shank, to which is jointed at H a sleeve containing the carbon pencil D, held in place by a clamp-screw. The conductor C leads to the positive pole of the source of electricity. The other pole of the source of electricity is connected to the metal to be operated on. When the carbon D, under these conditions, is brought into proximity to the metal to be operated on, a voltaic arc will be produced between the two, with the effect of heating, softening, and finally melting the metal at the point where the arc meets it.

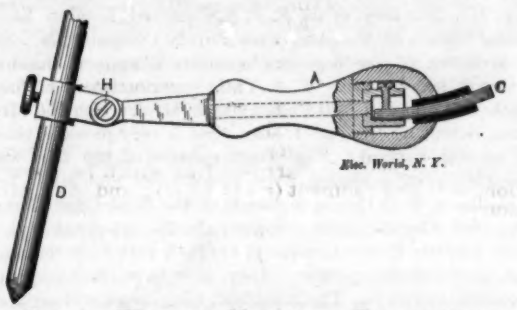


FIG. 1.—WORKING METALS BY ELECTRICITY.

The holder can be moved over the metal from one point to another to act on it in a continuous line, or at separate points, as desired.

The apparatus shown in operation in Fig. 2 consists, also, of a wooden handle A, having a flat base A', which rests upon and can move over the two metal plates $r\,r'$ to

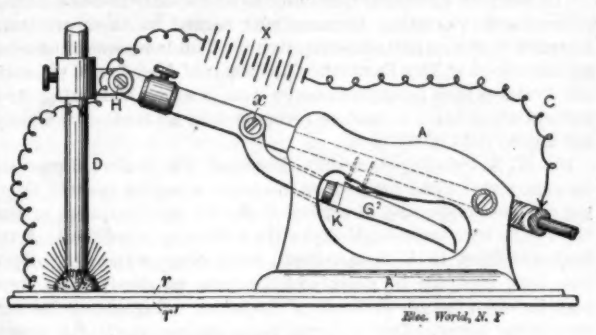
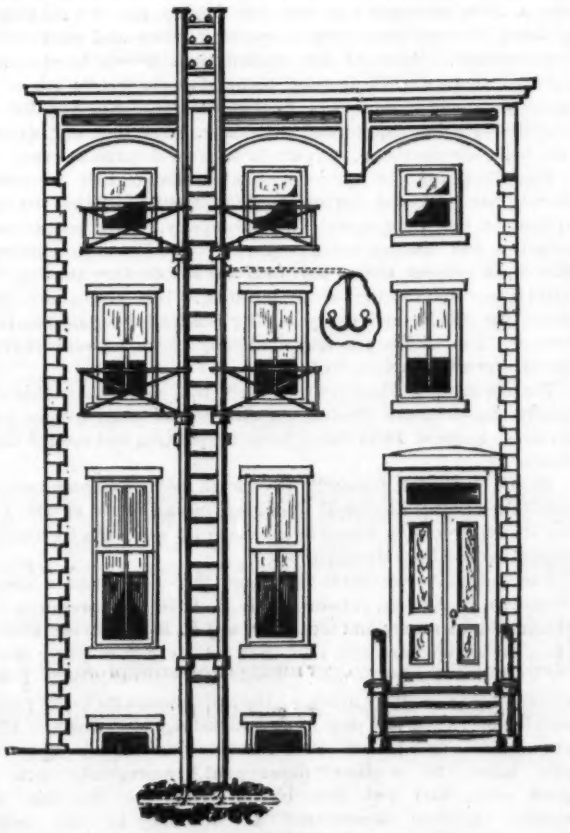


FIG. 2.—WORKING METALS BY ELECTRICITY.

be operated on. The conductor C for the carbon leads from the positive pole of the source of electricity X, and the other pole of the battery is electrically connected to the plates $r\,r'$, as shown.

The stem is a two-part stem joined together at x, and its front end is continued back of the joint in the form of



CLOKEY'S BRANCH ELECTRIC CONDUIT.

a lever G^2, which extends under the handle A. A spring K keeps the carbon D lifted, thus maintaining a normally open circuit. By pressing lever G^2 toward the handle, the carbon can be lowered into proper proximity to the plates $r\,r'$ to produce between it and them the voltaic arc. In the illustration the apparatus is shown in operation uniting the two plates by a process akin to riveting. By the action of the voltaic arc the metal is gradually melted, the fusion extending through into both plates, the melted portions of which are mingled together, so that when the same cool, the two plates, as to the fused portions, are virtually in one homogeneous piece.

According to the inventors, the process is susceptible of a wide range of application. It can be used, for instance, for joining metals whether end to end or placed one on top of the other, for making holes in metal, or for dividing a piece of metal into two or more parts, for steelifying, and for numerous other purposes.

Clokey's Electric Branch Conduit.

In order to avoid the running of wires for electric lighting and other purposes through walls and ceilings by circuitous paths, Mr. J. M. Clokey, of Decatur, Ill., has recently designed and patented an arrangement by which the former are run directly to every floor from the outside of the house. The wires for lighting connected to the street main are run up through a vertical conduit, as shown in the accompanying illustration, and then distributed direct to each lamp, the wires being attached by removing any of the removable tubes.

The tubes are also provided with ladder attachments by which wires can be readily strung in them, and at the same time they afford a means of escape to the occupants of the building in case of fire.

Mr. Clokey has also designed a method of suspending arc lamps across a street, which consists in combining a light lattice bridge spanning the street and resting on the tops of the conduit tubes.

A New Theory Regarding the Circulation of the Blood.

In a paper recently read before the Elkhart County Medical Association, at Elkhart, Ind., Mr. Wilber L. Stonex, A. M., brought out a theory of his own by which he seeks to explain the circulation of the blood.

This theory, which he has deduced from his investigations, is, that electricity is the motive power which causes the blood to circulate. The electricity is taken from the air which is brought into the lungs by respiration. From the lungs a vast number of nerves run directly to the brain, and by these nerves, which are perfect conductors of electricity, the electricity is conducted to the brain. Each nerve is insulated by being surrounded by a membrane which is a non-conductor. At the brain each nerve terminates in a cell, which is, in construction, a tiny Leyden jar, and these cells are in fact a battery of such jars. From these cells two sets of nerves pass to the heart, one nerve proceeding from each cell, and each set, or system, of nerves being wholly distinct and separate from the other. One set goes to the right heart and one to the left, and the flow of the electric current is to each alternately.

To illustrate the application of the electric force in the circulation of the blood, Mr. Stonex assumes that the electricity conducted to the heart from the brain is positive. Then, if the right auricle is charged with positive electricity, it will attract toward it from all parts of the venous system the particles of negative blood, and the result will be to fill the right auricle with blood. The blood there becoming, by contact, charged with positive electricity, will be repelled from the right auricle, and thence forced through the right ventricle to the lungs, thence to the left auricle and thence through the aorta into the arterial system.

At the lungs the blood seems to undergo a marked change in which it loses its positively electrified character. It would seem that at the same time that the positive electricity is taken from the air into the lungs to be carried to the brain, the positive electricity is also taken from the blood, and the blood becomes charged with negative electricity. Assuming this to be the case, the course of the blood in its circulation through the human system and the application to it of the propelling force, are as follows: The veinous, negative, blood is attracted to the right heart which is charged with positive electricity from the brain; there it becomes positive and is repelled from the right heart, and passes to the lungs where it becomes negative again. Becoming thus negative it would be drawn back into the right heart by its positive attraction but for the valves in the pulmonary artery which close upon it, and the passage to the left heart being open, and the left heart being also positively charged from the brain, the blood is drawn from the lungs into it, whence it, becoming charged with positive electricity, is again repelled and passes out into the body through the arterial system, passing through the capillaries into the veins, whence it is drawn again to the right heart.

In passing from the arteries through the capillaries into the veins a change takes place which affects both the character and color of the blood. The positive electricity is apparently taken from the blood, where it becomes an important factor in the process of combustion which is there being continually carried on, and it becomes negative again.

In addition to the direct attractive and repellant force exerted on the blood by the electricity, there is also, probably, a considerable muscular force exerted on the blood at the heart by the alternate expansion and contraction on the walls of the heart, but this, instead of being a distinct and independent force, is the result of the passage of the electric current from the brain to the heart. This is shown by the common experiment of passing a current of electricity through a heart, and, indeed, in this experiment Mr. Stonex finds one of the clearest proofs of the correctness of the theory advanced in his paper.

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OFFICE OF THE ELECTRICAL WORLD,
NEW YORK, June 7, 1887.

The American Electric Manufacturing Company are already settled in their new quarters in the Metropolitan Telephone building, where they occupy one of the main floors throughout. A light shaft in the centre gives good light and air to the offices all around the four sides. The five front rooms on Cortlandt street are occupied by the executive department, where Mr. E. H. Goff, the president, is to be found conducting, as is his wont, a large amount of business with personal attention and direction. From his office he can overlook the large and spacious salesroom where are exhibited specimen dynamos finished in handsome style, also some of the ornamental arc lamps, single and double, projectors for locomotives, search lamps for steamships, commercial arc lamps in all sizes, Wood cut-outs, voltmeters and ammeters. The directors have an elegantly furnished room. Comfortable accommodation is also provided for the other representatives and agents of the company.

Mr. C. Baxter's place, 40 Fulton street, Brooklyn, looked very busy last week when I called on that gentleman. He is carying on a large business there in the manufacture of electrical goods and supplies, and has special facilities for turning out annunciators, burglar alarm, box, skeleton, and iron frame bells, push buttons, etc.

The house of Ostrander & Peck, 21, 23 and 25 Ann street, deserves great credit for the manner in which they have combined electrical specialties with their well-known "oral goods." They have a big factory in Brooklyn where they make every variety of bells, push buttons, etc., in connection with oral or pneumatic annunciators speaking tubes and whistles. Specialties of theirs are iron box bells and push buttons.

Wm. Lang & Co., of 123 Middleton street, Brooklyn, have unusually large facilities for making metal parts of electrical apparatus in any quantity. They have nearly 100 presses as well as stamps, lathes, planers, and special machinery of all kinds. They keep a force of several men making new dies, and others on new tools for lathes, etc. Their facilities in this direction have already secured for them the trade of electrical manufacturing concerns.

Mr. H. M. Raynor, 25 Bond street, New York, is, I believe, the oldest manufacturer of platinum in this city. Mr. Raynor is full of interesting news and statistics regarding platinum, its origin, uses, etc. The best platinum comes, according to him, from Siberia. Two or three years ago, Mr. Raynor met with considerable inconvenience from an accident. A fire occurred on one of the steamship wharves where he had a big imported lump of this valuable metal, and the whole mass found its way to the bottom of the North River. A diver had to be employed to fish it up again, and at last, after quite a chapter of accidents, he succeeded in getting it into his possession again. Mr. Raynor work the metal up into wire of all sizes, from that of a hair up to that for use in incandescent lamps. He also supplies it for experimental purposes and makes it into crucibles to be used for melting other metals in.

The C. & C. Motor Company, of 2 Wall street and 88 to 94 South Fifth avenue, are having a remarkable run on their motors in all sizes from 1/16 to 1/6 horse-power up to 1 horse-power. Later on they expect to meet the demand for larger sizes, but at present they have all they can do in filling orders for the smaller sizes in connection with which their reputation is already so well established. The motor and primary battery outfit continues very popular, but the demand is growing at a tremendous pace for motors to be put on lighting circuits, arc or incandescent, 20, 10 and 6½ ampères, and 60, 110 and 500 volts. The parts of all these motors in the various sizes are interchangeable, and all the points of convenience and applicability have been well studied out. It would, in fact, be hard to-day to find an enterprising local light company that has not given the C. & C. motor a trial and been pleased with it. In such places as Rochester, Buffalo or New York, for that matter, these motors are being placed on the lighting circuits a dozen at a time, but still the cry is for more.

The Commercial Patent Development Company, of 102 John street, are offering a portable telephone desk for the special convenience of telephone subscribers. This desk closes up flat against the wall, and when required for use can be thrown out with one motion, presenting a sloping pad on which any notes can be made of messages transmitted by telephone. No valuable room is taken up, but a great convenience is thus provided. Attached to the desk are a paper cutter and a roll of fine writing paper, so that a conversation as long as one of Senator Evarts' speeches can be received and taken down without any delay or interruption in the way of getting more paper. The desk is made of polished ash or cherry, and altogether seems quite a desirable adjunct to the telephone station.

The Empire City Electric Company, 779 Broadway, New York, report exceedingly good trade through Messrs. Wark and Madden and at the home salesrooms. Their iron and wood box bells and insulators are selling into the thousands. The demand for wire in all sizes for telephone, telegraph, electric light and general use is surpassingly good. They have increased the staff of mechanics in their manufacturing department for making their gas lighters, medical batteries and for general work. House, office and hotel work, etc., is increasing. They are bringing out new and improved push buttons, also buzzers and telegraph instruments. Their new dynamo has just arrived for storing the accumulator put in some time since for lighting their salesrooms.

The Excelsior Electric Company, of 9 Dey street, New York, and 198-216 Willoughby street, Brooklyn, have issued this week their new and finely illustrated catalogue of electric light apparatus, motors for arc and incandescent circuits, electroplating and electrotyping machines, and machines for metallurgical purposes. The catalogue is a handsome and interesting production, with many fine illustrations, and it gives an admirable idea of the various appliances made and sold by the company, which, though it has never cared to resort to sensational methods of publicity has built up a remarkably large and solid business. The pamphlet gives a long list of users of the apparatus all over the country. It contains also price-lists, and the rules for conductors, of the New York Board of Underwriters. It is mentioned incidentally that the firm of E. Balbach & Son, at Newark, N. J., are depositing 60 tons of copper per week with 5 of the Excelsior dynamos. Mr. Wm. Hochhausen is the electrician and superintendent of the company, and Mr. G. D. Allen is the general manager.

The Electrical Supply Company, 17 Dey street, are agents for the mast arm of the Star Iron Tower Company, of which over 5,000 are now in use. The price of the arm is moderate in view of its great strength and general availability, and it is, in fact, surprising that an even greater number have not found their way into service. Their use, however, is now increasing very rapidly. The Electrical Supply Company carry also a full line of all kinds of electric light supplies, including globes, arc and incandescent fixtures, etc.

Mr. Theodore N. Vail, president of the Electrical Accumulator Company, and of the Metropolitan Telephone Company, was out on May 29 and 30 in his fine new yacht, the "Norma," with a number of friends and associates, among whom were Mr. E. J. Hall, Jr., Mr. Frank Jones, of the West Coast Telephone Company; Mr. Courtney, of the E. P. S. Company, London, England; General Elmer, of the American Surety Company; Mr. Eidlitz, the architect of the fine Metropolitan Telephone Building in Cortlandt street; Mr. W. A. Vail, superintendent of the Law Telephone Company, 140 Fulton street; Mr. Parrish and Mr. Pendleton, patent attorneys. I hear that a very pleasant time was had, as was natural. A pleasant episode of the trip was the presentation of a chased silver punch-bowl and ladle by Mr. Frank Jones, with the compliments of the West Coast Company.

The Daft Electric Light Company and its sub-organization, the Safety Electric Power Company, are both very busy meeting new demands for electric power. They now have under equipment six electric railways. The Mansfield, Ohio, road will need several cars and the same may be said of the roads at Ithaca, N. Y.; Pittsburgh, Pa., and Middletown, Conn. Asbury Park will take 15 cars. There is another road in view that I am not at liberty to mention yet. Between 45 and 50 motors are now building to be fitted on these cars. The demand for motors for stationary power purposes is also steadily on the increase.

Mr. J. W. Brewer, of London, is in this city looking up American specialties, it is said, in the interest of an English syndicate.

The Simplex Electrical Company have recently issued a couple of neat and interesting circulars with regard to their arc lamp intended to run on incandescent circuits. This lamp was illustrated and described in THE ELECTRICAL WORLD of May 7, and the various features then brought to notice are, it seems, attracting very general attention. It must be recognized by all that such a lamp has a good field of its own.

Mr. H. B. Priudle, electrician, Portland, Me., reported recently on some tests he had made upon insulated wires for electric lighting purposes under the direction of the Edison Company, of this city. The tests were made under the following conditions: A tin tank was filled to a certain depth with clear water; the depth was kept constant by daily addition; the insulated wires were bent in bows, the exposed ends of the wires being above the surface of the water. The tank was made one terminal of a circuit of 1,100 volts, and the wire in the water was made the other terminal. Excluding rubber coverings, all the insulations excepting the "Campbell" (T. Z. R.) of the Simplex Company, it is asserted, gave way in from one minute to four hours and forty minutes. The "Campbell" remained intact for six days and twenty-two hours, during which time the current was on an aggregate of eighty-three hours.

I called upon Messrs. Hazazer and Stanley, 32 and 34 Frankfort street, during the past week, and found them extremely busy. I was a little astonished at the fine display they are making of polished bronze letter boxes, speaking tubes and push-button combinations. Some of the combinations shown have a plain polished surface with beveled plate glass in front; others are more ornamental and have figured designs. The firm tell me that they are doing quite well with these, while their old specialties, bells, annunciators, etc., are in as great demand as ever.

The Electrical Committee of the Equitable Life Insurance Society have selected for use in the Equitable Building the time system of the Telegraphic Time Company. Such satisfactory promises and guarantees have been received from the company that it is evident that a universal and satisfactory time service will be provided for the whole building. The offices are well wired for clocks, and every facility is afforded for electric time service. The clocks are inspected daily, and synchronized from the Western Union time-ball.

The Telegraphic Time Company now has on rental in this city nearly one thousand electric regulators and dials giving good service. Some of these have been in position and use for three years.

Mr. C. H. Carter, formerly electrician and superintendent for the United States Electrical Company, has an office at 286 Fulton street, Brooklyn, where he gives special attention to medical apparatus and burglar alarm work.

The Mutual Accumulator Company, 292-4-6 Graham street, Brooklyn, R. Arnold, president; J. E. Otis, vice-president; L. H. Arnold, secretary and treasurer, and E. R. Knowles, electrician, has its new factory busily engaged already in filling orders for its Julien storage battery. Looking in the other day, I saw several workmen busy applying the active material to the plates, and the operation was one quite interesting to witness. After the grids or plates have been thus filled up, they are taken to another department, assembled, put in glass cells, and put into circuit with the charging dynamo. Another department is devoted to the preparation of the special metallic compound, with mercury, etc., and to the manufacture of the plates in the rudimentary grid form. In the basement is a large and neatly arranged machine shop. In a wing of the building the Julien motors are wound, and various special inventions of Mr. Knowles for controlling and switching the batteries are made. The company gives evidence of brainy management and great enterprise and has started in with the intention of making its mark.

W. T. H.

NEW ENGLAND NOTES.

BRANCH OFFICE OF THE ELECTRICAL WORLD,
BOSTON, June 7, 1887.

Clark's new hotel, corner Washington and Avery streets, has been equipped throughout with 16 c. p. incandescent electric lights furnished from the Edison central station.

At the Ferdinand street station of the Boston Electric Light Company another (second) of the Sun Electric Company's dynamo machines (alternating system) is being placed in position for immediate work.

Messrs. Kimball & Davis, manufacturing electricians of this city, are filling quite a number of orders for small dynamos (used as "exciters"), to which branch they are giving especial attention.

A dispatch from Keene, N. H., dated May 31, states that that city has contracted for 20 arc lights of the American system, to be introduced July 1.

At a recent town meeting held at Beverly, Mass., it was voted to adopt electric lights for the illumination of the principal streets and it was decided upon to contract with an electric light manufacturing company for at least 20 arc lights. It is not yet known what system is to be used.

The town of Spencer, Mass., has contracted with the N. E. Ball Electric Light Company—through H. M. French, manager—for 60 arc lights for a period of three years, commencing July 1. By the terms of the contract alluded to, the lights are to be burned from dark until midnight.

The Edison Electric Light Company, of Brockton, Mass.—according to a special dispatch to the Boston *Herald*, dated June 2—"still continues to make extensive improvements on its plant. New engines are to be set up, which will make five in all, giving proportionately facilities for extra lighting. Work on laying the underground feeders and wires will begin this week."

The selectmen of Pittsfield, Mass., have decided that the board has no authority to grant a permit to the electric light companies to erect poles on any street which has been curbed, as such walks, after being accepted by the authorities, are under the control of the sidewalk commissioners. District-Attorney Waterman decided recently that "the old board had no jurisdiction in the premises, and the electric light companies must now make another application respectively to the sidewalk commissioners in order to carry out their plans.

At the annual meeting of the Washburn & Moen Manufacturing Company, Worcester, Mass., on June 1, the following directors were chosen, viz: P. L. Moen, C. F. Washburn, F. H Dewey, P. W. Moen and C. G. Washburn.

It is rumored that Mr. J. N. Keller, who was until recently identified with the Bell Telephone Company's offices in this city, is to become general manager of the Boston Steam Heating Company.

The Bickford Railway Station Indicator Company, of Boston, will hold its annual meeting at Portland, Me., on June 8. It is reported that the company will reorganize and the name be changed to the Bickford Railway Electric Company.

The Curtis Regulator Company, Boston, Mass., reports great activity. Its sales for April were as follows: Steam regulators, from 1 in. to 5 in.; return traps, damper regulators, expansion traps, pump and water regulators and carbonic acid gas regulators: Massachusetts, 39; Connecticut, 1; Rhode Island, 1; New York, 20; Pennsylvania, 4; Ohio, 1; Minnesota, 2; Nova Scotia, 2; Copenhagen, Denmark, 1.

The Massachusetts Lord Acoustic Company, a sub-company of the Lord Acoustic Telephone Manufacturing Company, has reorganized and elected a permanent board of officers, with H. W. Wilson as president; Edward H. Childs, treasurer, and John W. Cartwright, manager.

A dispatch from Bar Harbor, Me., dated June 4, says: The electric light plant which is being established here will, it is expected, be in working order by the 15th instant. There will be 20 miles of wire through the village, and 100 poles. The company will furnish both the arc and incandescent lights, and the latter will be kept burning all night. The grounds of a number of cottages will be lighted by them, so that lawn tennis can be played evenings. Most of the hotels will also be lighted with the incandescent.

Messrs. Thomas B. Adams & Company, manufacturers of belting, No. 54 Federal street, Boston, report a sale of their special dynamo belting to the Bar Harbor (Me.) Electric Light Company. The order consists of 230 feet of 11-inch and 25 feet of 7-inch double belting, for connecting the dynamos with the shafting, and 85 feet of 34-inch belting (also double) for use as the "main driver," from engine to shafting. This order, says Mr. Adams, will probably be increased at an early day.

Mr. C. A. Perkins, late city engineer and superintendent of streets for the city of Malden, Mass., has resigned those positions to accept the office of superintendent of the Boston district of the New England Telephone and Telegraph Company recently made vacant by the resignation of Mr. D. B. Parker. Mr. Perkins was at one time connected with the Boston city engineering department, and when Mr. J. P. Davis was appointed to office on the staff of the American Bell Telephone Company the former joined the staff of the latter in the capacity of civil engineer. Subsequently Mr. Perkins was appointed to an important position in the same corporation, which he filled in a creditable manner as long as he remained in the employ of the Bell Company. The long experience of this gentleman on the staff of Mr. Davis, and in the other positions referred to, coupled with his electrical knowledge and executive ability, is sufficient evidence that the New England Telephone and Telegraph Company has been fortunate in securing his services as successor of one of its most efficient, energetic and respected officers. Now that the company is about entering on an extensive scale upon underground wiring, the training of Mr. Perkins in work of this kind will certainly prove invaluable to the interests he now represents.

The Jarvis Engineering Company, Boston, Mass., report their business very good, especially in the line of erecting electric light stations. Among their orders for this class of work is installing a steam plant for the Burlington Gas Company, Burlington, Vt., who are putting in the Brush system, to use a 150 h. p. boiler set with the Jarvis setting and two 60 h. p. Armington & Sims Company engines; Dover Electric Light Company, Dover, N. H., Thomson-Houston system, one 150 h. p. tubular boiler with the Jarvis setting, and two 60 h. p. Armington & Sims Company engines; Nashua Electric Light Company, Nashua, N. H., two new 90 h. p. Armington & Sims Company engines, and setting a new tubular boiler with the Jarvis setting; Franklin Electric Light Company, Franklin, Mass., Thomson-Houston system, one 60 h. p. Armington & Sims Company engine; Northampton Electric Light Company, 70 h. p. Armington & Sims engine and a tubular boiler set with the Jarvis setting; Springfield Electric Light Company, setting two boilers with the

Jarvis setting; setting new boiler with the Jarvis setting for the Newburyport Electric Light Company, Newburyport, Mass., and a 60 horse-power Armington & Sims Company engine; New Haven Electric Light Company, tenth engine of Armington & Sims make; 50 horse-power engine to Millbury Electric Light Company, Millbury, Mass.; setting three boilers with the Jarvis furnace for the Halifax Electric Light Company, Halifax, N. S.; setting four Heine boilers for the Colorado Electric Light Company; setting new boiler for the Brush Electric Light Company, Savannah, Ga., with the Jarvis furnace.

A private dispatch from Austin, Tex., says: "Judge McCormack has granted an injunction covering all the infringing telephones in Texas, and contempt of court proceedings have been instituted." This closes up the entire opposition in Texas that has been an annoyance to the Erie and American Bell telephone companies for the past three years, and will largely increase, it is said, the income of the Erie Company. The opposition, it is alleged, had as many as 1,000 subscribers in Texas, while the Erie company has nearly 4,000 in that section.

Erie Telephone's annual report is out and makes this excellent showing:

Total earnings	$540,618
Total expenses	360,544
Net earnings	$180,074
Construction	33,167
Net over all	$146,907
2½ per cent. dividend	120,000
Surplus	$26,907

Erie closed strong at 35⅝. It earned about $2,000 over 3 per cent. The outlook is good. W. I. B.

PHILADELPHIA NOTES.

PHILADELPHIA, Pa., June 6, 1887.

Electrical and political affairs are necessarily intertwining themselves at present in this city. Before important schemes can be practically formulated it is necessary that the law-making power of the municipality be consulted, and as there are a number of competitors for city privileges, it follows that the political wires are worked industriously. A half-dozen or more schemes involving electrical interests in various degrees are now in hand. On Thursday the Electrical Committee of Councils favorably reported ordinances giving underground privileges to the Edison Electric Light Company and to the Keystone Light and Power Company. There is a great stir among all of the companies. A high authority stated recently that there was upward of $200,000 worth of business to be awarded during the next four weeks in the city and throughout the State.

The International Printing Telegraph Company, of Philadelphia, will in a few weeks be prepared to go into business. Machines are now being made for the recording of telegraphic messages automatically, as type writing, in lines six inches wide. It is the only machine that prints on a sheet, and the system can be worked on an exchange system. It renders tampering with lines impossible, and threatens to render the services of operators unnecessary, to the extent at least that it is adopted.

Shaw & Geary have introduced an improvement in call bel's and buzzers. They use Norway iron for the frame instead of cast iron, because the former resists polarization, which as all users of bells know, interferes with the efficiency of the armature. The usual but futile remedy has been and is to add another battery. This firm are now fully equipped to introduce their various specialties and novelties, such as a window spring burglar alarm and door and floor push.

The Schuyler Electric Light Company has been reorganized as the Schuyler Electric Manufacturing Company, branch office from the Hartford, Conn., office, 55 South Third street, Stephen Holbrook, manager. The liabilities of the original company, some $350,000, have been absorbed in the preferred stock of the new company, and everything is now in readiness for active operations. The new management has two or three good sized irons in the fire, and under Mr. Holbrook there is no danger of any of them burning.

The Millville-Schuyler Company, with a capital of $40,000, has installed a 50-arc light plant at the busy manufacturing village of Millville, N. J. The contract price is $4,500 per annum. The gas company awoke from a Rip Van Winkle sleep, and, after turning heaven and earth on a popular vote against the base intrusion of electric lights on the sanctity of their hearthstones and streets, shrank into retirement with a vote of eleven electric councilmen against one gas councilman. The capacity of the plant is 100 lights, one-half of which will be devoted to private purposes. The Franklin Electric Light Company, of Cape May, using the Schuyler system, have increased their capacity from 50 to 100 lights to meet the extending demands. The Russell Engine Company, of Massillon, O., had the contract for the automatic engine. The minimum requirement is 40 lights all the year around, and the rest are required when the season is on.

Messrs. Walker & Keplar, representing the Edison interests, have the contract for 70 lights at the Ridge avenue "merry-go-round;" also the 200-light contract at Downingtown

The supply houses have all had a busy season. The dull period is due, but it will not make much of an impression on some concerns. The electric light business, like all others, is getting into a rut, where business comes along in any event. Opportunities for big operations are being watched and cultivated.

The Cleverly Electrical Works, at 1018 Chestnut street, are crowded for space, and are loaded up with urgent orders for appliances for lighting gas with electricity.

The electric light plant of the Fort Wayne Jenney Company at Girard College, mention of which was made last week, is creating so much favorable comment that a further reference will not be out of place. As before stated, the plant consists of seven towers and 50 lights. The towers were manufactured by the Star Iron Tower Company, and are very graceful structures indeed. They are so constructed as to offer the least resistance to the wind and at the same time, are strong and durable. They stand without guys of any kind, and being made of solid iron with sleeve joints, there is no danger of rust setting in and corroding the iron supports, or of the joints becoming loose and allowing the tower to buckle over. The Star Iron Tower Company have placed many towers throughout the West and South, all of which have safely withstood the action of storms and cyclones. The wire used at Girard College is all put underground. The Waring cable was selected, and the work was done by the Standard Underground Cable Company of Pittsburgh. In ascending the towers, the cable is drawn up a groove in the leg of the tower and the groove is afterwards covered with galvanized iron sheeting. Every precaution is taken against grounds or damage to the cable in any way. Each tower is provided with a terminal box and each loop with a cut-out box placed at the junction of the loop with the main circuit of the cable. The apparatus of the Fort Wayne Jenney Company appears to be very simple and durable in construction, and the light given is certainly very steady and penetrating. The entire 44 acres on the grounds is lighted better than under full moon. The company should be proud of its achievement. The branch office, from which the work was caried out, is at No. 26 North 7th street.

South street is being torn up for underground wires. Underground work is being vigorously pushed in other sections of the city.

WESTERN NOTES.

BRANCH OFFICE OF THE ELECTRICAL WORLD,
CHICAGO, June 4, 1887.

Business generally is active and the many new developments now progressing promise that it will remain brisk for a long time to come.

The Chicago Arc Light and Power Co. have closed a lease with the Chicago Warehouse and Manufacturing Co. for a large portion of the basement and also upper rooms in the former company's great manufacturing building, fronting some 600 feet upon Market and Washington streets and the Chicago River. It will be used by the lessees as their central station for supplying 2,500 or more arc lights throughout the business part of the city—requiring engines and dynamos of more than 2,000 horse-power.

At the meeting of the City Council on June 3 Mayor Roche sent a message to the council in reference to the bridge nuisance. In it he said: "At every seaboard city vessels are obliged to wait for the tide in order to get in or out of the harbor. The hours of arrival and departure are fixed by a natural law, and no one complains. Here vessels are accustomed to come in and go out at all hours of the day, to the great inconvenience of the public. With the river lighted by electricity, the river and bridges opened for six hours at night, it seems to me the arrival and departure of vessels can be controlled so as to obviate in a great measure complaints of interruption of travel. I therefore suggest," he said, "that the bridges on the river on the south branch to Twelfth street, and on the north branch to Chicago avenue be open from 12 o'clock midnight until 6 A. M. during the season of navigation, and the bridges at Clark, Adams, Madison, and Twelfth streets be closed at intervals of an hour for three to five minutes if necessary for the crossing of street cars, vehicles, and pedestrians. The bridge tenders should have limited authority to open the bridges during the day in October and November, or whenever storms occur, for the passage in of vessels, and provision should also be made for the opening at other times when a vessel is in distress. An arrangement can easily be made by which the various bridges may be connected with the fire-alarm office, so that in the event of a fire the men in charge can be notified in time to close them for the passage of the fire apparatus. The Corporation Counsel advises me that the city council has the power to order the opening, and also that a portion of the appropriation for gas can be used for the electric lights. The mayor submitted the estimates of City Electrician Barrett of the cost of lighting the river by electricity. The cost of the plant he placed at $47,750, and of operating it per annum $7,300. The plant, he thought, would displace 400 gas lamps, which cost $20.80 each per year.

Col. S. G. Lynch, broker, 146 La Salle street, Chicago, furnishes me the following telephone stock quotations:

Bell of Mo	$155@$157
Central Union	48@ 49
Chicago	385@ 400
Colorado	20@ 22
Cumberland	80@ 85
Great Southern	30@ 33
Michigan	76@ 77
Rocky Mountain Bell	40@ 45
Wisconsin	105@ 107

THE TELEGRAPH.

T. M. B. A.—Assessment No. 207 for June for one dollar has been made to meet the death claims of George A. Cole and Donald C. McVean. This assessment is due from members holding certificates up to and including numbers 658, B 25, C 3 and D 2.

Telegraphs in South America.—Mr. V. H. MacCord writes us from Arequipa, Peru: "We have just finished the telegraph line from the coast at Mallendo, Peru, to La Paz, Bolivia, and shall very soon extend our line from Puno to Cuzco. We have in operation now about 500 miles of line."

THE TELEPHONE.

East Tennessee.—It is stated that the controlling interest in the East Tennessee Telephone Company has been secured by parties at Nashville. Mr. O. F. Noll, the president of the Cumberland Telephone and Telegraph Company, has been elected president of the East Tennessee Company.

Texas Infringers.—In his last bulletin, Gen. Barney says: In June last the American Bell Telephone Company instituted suit for injunction against the Pan-Electric telephone companies operating in Texas, five in number, viz.: The Texas Pan-Electric Company and local companies operating exchanges at Denison, Abilene, Forth Worth and Dallas. The cases were heard in November last, and no defense being attempted the companies were all enjoined and the court granted ninety days in which to wind up their affairs. At the expiration of that time the exchanges at Abilene and Denison obeyed the order of the court in letter and spirit and ceased operations, but in Fort Worth and Dallas, where the Pan companies had an aggregate of 600 subscribers, an ostensible lease of lines and apparatus was made to one Watkins, who had been employed as manager of the Pan Company at Fort Worth. When the day arrived on which the injunction was to go into effect it was found that slight changes had been made in receiver and transmitter, and the infringement continued until the night of May 8, 1887, when a restraining order, granted by Judge Pardee, was served upon the new owner, and the two exchanges mentioned were summarily closed.

THE ELECTRIC LIGHT.

De Land, Fla., is to have an electric light plant, it is said.

Mobile, Ala.—The Seaboard Manufacturing Company is to erect an electric light plant.

Natchez, Miss.—Steps are being taken to form an electric light company at Natchez.

Tuscaloosa, Ala.—Steps are being taken for the erection of an electric light plant at Tuscaloosa.

Honey Grove, Tex.—The Edison Electric Light Company, of Dallas, Tex., is negotiating for a proposed plant at Honey Grove.

Glens Falls, N. Y., will have the Thomson-Houston system of lighting, and the dynamos will be run by two 13 × 12 Ball engines.

Napoleon, O.—The Napoleon Electric Light Company has been incorporated by A. Beard and others, with a capital stock of $15,000.

Tallahassee, Fla.—A bill was introduced recently in the Florida Legislature to charter the Pensacola Electric Light and Power Company.

Charleston, Ill.—The Charleston, Ill., Electric Light Company has been incorporated by Mr. J. W. X. Neal and others with a capital stock of $15,000.

Waterloo, Ia.—The C. W. Harvey Electric Light Company, of Waterloo has been incorporated by Mr. Harvey and others with a capital stock of $40,000.

Carthage, N. Y.—The American Electric Light Company, of Carthage, N. Y., has been incorporated by V. K. Kellogg and others, with a capital stock of $,500.

Buffalo, N. Y.—The Battery Light and Power Company, of Buffalo, N. Y., has been incorporated by C. H. Gibson and others, with a capital stock of $1,000,000.

Fort Worth, Tex.—A local Edison Company has been organized by Mr. J. G. Watkins and others, and will begin operations with a plant of 2,000 lights capacity.

Atlanta, Ga.—The Thomson-Houston Electric Company will erect a plant at Atlanta, Ga., and have ordered their steam plant from the Ball Engine Company, of Erie, Pa.

Tampa, Fla.—The Tampa Electric Light & Power Company succeeds the Tampa Electric Light Company, with a capital stock of $30,000. Mr. J. T. Lesley is the president.

Garrettsville, O.—Mr. W. L. Udall has in position and ready for operation at Garrettsville a plant of 300 incandescent light capacity of the Brush-Swan system. It is proposed to light the streets, business places, churches, lodge rooms and residences.

New York City.—Messrs. Powelson & Hall, of 115 Liberty street, New York City, engineers and contractors, have just closed a contract with the Manhattan Beach Improvement Company for a 9 × 12 Ball engine to drive the Thomson-Houston dynamo.

Washington Territory.—Messrs. Mitchell & Sparling, agents for the Edison Electric Light Co., of New York, have just closed a contract to light a large Insane Asylum at Fort Steilacom, Washington Territory. The dynamo will be driven by a 10 × 12 Ball engine.

South Amboy, N. J.—Mr. George Such, of South Amboy, N. J., has contracted for a 100 Edison light plant for his fine new mansion at Emston, N. J. The plant is to be driven by power furnished on the premises. The order has been secured by J. W. Schroeder, agent for the Edison system for New Jersey.

Detroit, Mich.—The Brush Electric Light Company, of Detroit, are increasing their works, and will soon be in their new building on Foundry street. They are using three Ball automatic cut-off engines, and have just ordered five additional 13 × 12 engines from the same company.

New Orleans.—Mr. C. Edmund Kells, Jr., D. D. S., is now with current from the Edison circuit obtaining and daily using light, from an incandescent mouth lamp; power, C. & C. motor and electro-magnetic mallet; heat, water is kept constantly warm by the current, and cold, fan giving breeze. In view of these varied results Mr. Kells inquires, what next?

St. Louis, Mo.—The Western Electrical Construction Company has just completed installations as follows in St. Louis: a 250-light Edison plant for Meyer Bros. & Co., druggists; a 350-light Edison plant for the Woodward & Tiernan Printing Co.; a 400-light increase, Edison plant, in the *Globe-Democrat* office; a 200-light Edison plant for Pecant & Racine, De Soto, Mo.; and a 200-light increase Edison plant for the National Manufacturing Co., Nashville, Tenn. Mr. A. H. Reece, the agent of the Edison United Manufacturing Company, has also sold many other plants in his territory.

APPLICATIONS OF POWER.

Dayton, Ky.—The Newport & Dayton Street Railway Company will operate its road by electricity.

Asbury Park, N. J.—The Seashore Electric Railway Company of Asbury Park has been incorporated by Henry S Iselin and others, with a capital stock of $100,000.

Detroit, Mich.—The East Detroit & Grosse Point Electric Railway Company has just been formed, and will at once procee to build its road, using the system of Mr. F E. Fisher, of the

Detroit Electrical Works. The road will be 8 miles in length. One mile will be within the city limits, and on that section a conduit will be used. Over the other part of the road the conductor will probably be a third rail. The power station will consist of two 80 horse-power steel boilers, two 60 horse-power automatic engines, and two dynamos. Each of the dynamos will be of sufficient power to handle the entire system. The working equipment will consist of four 16 ft. cars, with motors on the front platform, and 2 motors of sufficient power to draw 3 open cars at a speed of not less than 25 miles per hour. The road will follow Jefferson avenue to Cadillac Boulevard, thence following the Mack road to Grosse Point, which is a very fashionable suburb of Detroit, where most of the wealthy people have fine residences. The object of the road is to place that suburb in easy communication with the city.

Lynn, Mass.—A specially interesting feature of the industrial exhibition at Lynn is a long stretch of shoe machinery in full operation, driven by a 15 h. p. Thomson-Houston electric motor.

Sprague Motors.—Over 2,500 h. p. of Sprague motors is now in use and in process of installation. One of the recent equipments is that for the Western Knitting Company, Detroit, on knitting and winding machines, employing between 200 and 300 hands.

Findlay, O.—The celebration of the first anniversary of the use of natural gas in the mechanical arts at Findlay was held on June 8, 9 and 10. The programme of the special features of the celebration included the laying of the first rail of the Findlay electric street railroad.

PERSONALS.

Mr. D. B. Parker, recently connected with the New England Telegraph and Telephone Company, will, it is reported in Boston, be appointed to the position of special agent for the American Bell Telephone Company, formerly held by the late Mr. Boyd.

Mr. W. S. Frear has just been promoted from his position of secretary of the Brush Electric Light Company, of Buffalo, to that of general manager of the company. The position is a new one, the necessity for its creation having arisen out of the growth of the company's business. Mr. Frear has been secretary for the last four years.

Mr. E. H. Johnson, president of the Edison Company, has just returned with other members of the New York Riding Club from making a long ride on horseback through New Jersey, Pennsylvania and New York States, taking in the Delaware Water Gap and the Catskills. The party consisted of ten members, accompanied by three grooms, two supply wagons and six extra horses.

Mr. P. C. Ackerman.—The American Electrical works, of Providence, R. I., have removed their New York office from 15 Cortlandt street to the Metropolitan Telephone Company's building, 18 Cortlandt street, where they will carry a line of their staple goods of telephone, telegraph and electric light insulated wires. Mr. P. C. Ackerman will have charge of their business, vice Mr. Harry Hall, resigned, and will be pleased to see all of the old customers, believing that any one in want of insulated wire in any form will find it to their interest to call.

Mr. Harry Hall, formerly representing the American Electrical Works, in this city, has resigned his position and has become connected with the Edgerton Electric Motor Company of Philadelphia.

Mr. George Westinghouse, Jr., has adopted the plan of giving all his employés a half holiday on Saturday. Also baths will be erected at the works, and it is said a library will be fitted up for the use of the workmen.

Mr. Charles Lever, of England, the well-known inventor of the Lever arc lamp and other apparatus, is now in this country. This is not the first visit paid to America by Mr. Lever. It will be remembered that on the last occasion he published a series of interesting articles in the London *Electrical Review* on his observations.

Mr. Knud Bryn, General Manager of the Christiania Telephone Company, of Norway, and Mr. Ludwig Spoerck, the owner of the telephone exchange at Drontheim, Norway, are at present on a trip of inspection in this country, and have been callers recently at this office. Both gentlemen are intelligent observers and critics, and will no doubt carry home with them many notes as to American ways of doing things telephonic. The Christiania office has a Western Electric equipment and about 1,600 subscribers, at rates from $25 to $30 a year. The population of the city is 130,000.

MISCELLANEOUS NOTES.

The Gill Electric Combination Lock Company has been organized in New England for the purpose of manufacturing and dealing in electric combination locks and electric apparatus. President, Henry Waterman; treasurer, Russell Bradford; directors, Russell Bradford, C. B. Southard. Capital stock, $500,000.

National Electric Light Association.—A meeting of the Executive Committee of the National Electric Light Association takes place this week at Boston. At this writing it seems likely that the Hotel Vendome and the end of August will be the place and time of the next convention. There are whispers also of Nantasket.

A Western Electrical Journal.—We understand that early in July the first number of the *Western Electrician* will be issued in Chicago. The editor and manager will be Mr. W. A. Kreidler, who is well known as the Western representative of THE ELECTRICAL WORLD. There is little doubt that a live electrical paper will find plenty of elbow room in the West; and the present enterprise is certainly in good hands. We shall be glad to give our new contemporary a hearty welcome when it makes its appearance.

Large Orders.—The Standard Underground Cable Company, of Pittsburgh, have recently closed a contract with the District of Columbia for a system of underground wires for the police and fire departments, telephones, etc. There will be used 75,000 feet of cables, containing from 2 to 13 wires each. The first of a large shipment of Standard cable to New York for the Western Union Telegraph Company was make last week. It embraces over 300 miles of wire. The contract with the company is for 2,000 miles, the cables containing 19 to 30 wires each. This contract will take two weeks to fill. The work in New York will be begun in a few days.

BUSINESS NOTICES.

Jordan & Gottfried, 208 Canal St., N. Y., carry a complete stock of iron and brass machine and wood screws, bolts, cap and set screws, taps, dies, files, twist drills, brass and rubber in tubing, rod and sheet copper, brass, German silver, steel and iron wire, shafting, tools, etc.

STOCK QUOTATIONS.

The following list, compiled by Mr. W. H. Baker, member New York Stock Exchange, 16 and 18 Broad street, gives the current quotations of electrical stocks:

June 8, 1887.

TELEGRAPH.	Bid.	Asked.
Am. Dist.	.....	97
Am. Tel. & Cable	75	76
Cen. & So. Am.	95	100
*Com. Tel	.....	.....
*Gold & Stock	.....	.....
*Inter. Ocean Tel.	.....	.....
N. Y. Mutual	81	82
Pac. & Atl.	48	54
*Postal T. & C.	25	35
South. & Atl.	68	75
W. U. Tel.	78	78⅛
W. U. Scrip.	76	.....
W. U. Bonds	117	.....
Mut. U. Bonds	86	87
TELEPHONE.		
Am. Bell	221	222
Am. Speaking	110	120
Erie	32⅜	33⅛
*Hudson River	.....	60

TELEPHONE.	Bid.	Asked.
Mexican	.....	1⅝
*N. Y. & N. J.	87	92
N. Y. & Pa.	.....	.....
New England	43	44
*Southern Bell	125	135
ELECTRIC LIGHT.		
*Am. Electric	.....	.....
*Brush	.....	.....
*Brush Ill.	95	104
*Consolidated	.....	.....
*Daft	.....	.....
*Edison	137	140
*Edison Ill	99	100
*Edison Isolated	.....	.....
*United States	40	50
*U. S. Ill.	90	95
MOTOR.		
*Daft	.....	.....
*Sprague	.....	.....

* These stocks are so seldom dealt in that it is difficult to give prices at which they can be bought or sold. The figures given are as near as can be ascertained.

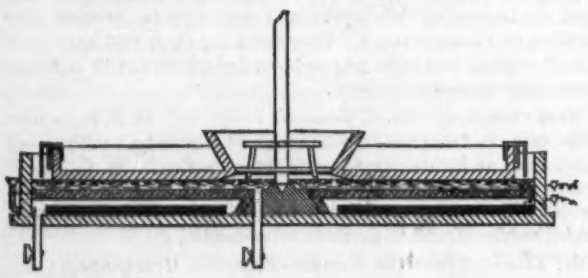
OUR ILLUSTRATED RECORD OF ELECTRICAL PATENTS.

PATENTS DATED MAY 24, 1887.

363,411. Apparatus for Amalgamating Gold; B. C. Molloy, of London, Eng. Application filed April 7, 1886. This apparatus secures an intimate and continued contact between the particles of the crushed ore containing the gold with the surface of the mercury to be used for the purpose of amalgamation. See illustration.

363,440. Secondary Electric Clock Movement; C. D. Warner, of Ansonia, Conn. Application filed Jan. 28, 1887. The object is to produce a secondary clock embodying the simplest form of adjustable construction practicable with the attainment of the utmost certainty and regularity of action. See illustration.

363,449. Telephony; J. J. Carty, of Cambridge, Assignor to The American Bell Telephone Company, of Boston, Mass. Application filed Jan. 9, 1885. This consists in the combination of a single variable resistance or set of contact-points with any



363,411. APPARATUS FOR AMALGAMATING GOLD.

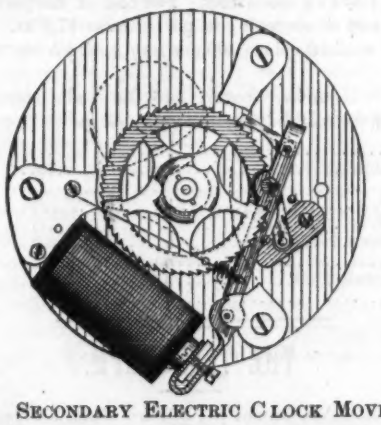
desired number of ordinary induction coils and batteries. See illustration.

(1) 363,463. Method of and Apparatus for Operating Pressure or Vacuum Brakes; (2) 363,464. Electro-Pneumatic Brake for Railroad Trains; H. Hollerith, of New York, N. Y. Applications filed Nov. 1, 1886. These devices relate to the well-known Westinghouse air brake, and are designed to brake all the wheels of a train of cars simultaneously.

363,466. Electric Motor and Dynamo-Electric Machine; R. M. Hunter, of Philadelphia, Pa. Application filed Oct. 15, 1886. A peculiar construction of field-magnet and method of coupling up the coils thereof. Independent field-magnet and armature circuits. The armature with its coils subdivided, the subdivision in each main coil being coupled together in multiple arc connection and the main coils in series. Means for shifting brushes automatically. See illustration.

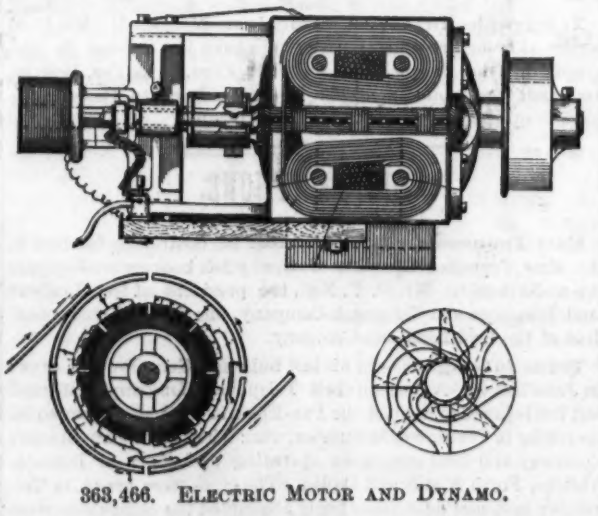
363,498. Primary Electric Pendulum Clock; J. Zenner, of Munich, Germany. Application filed Feb. 15, 1886. In this clock the pendulum is free in its oscillation, the contact ensues only when the arc of oscillation has reached a certain minimum limit, while the work the pendulum has to do is insignificant.

363,500. Incandescent Electric Lamp; C. G. Anderson, of Hartford, Conn. Application filed March 5, 1886. Improvements in the structural details.



363,440. SECONDARY ELECTRIC CLOCK MOVEMENT.

363,559. Incandescent Electric Lamp; W. Stanley, Jr., of Great Barrington, Mass., Assignor to G. Westinghouse, Jr., of Pittsburgh Pa. Application filed Oct. 8, 1885. The



363,466. ELECTRIC MOTOR AND DYNAMO.

special object is to produce a lamp and holder suited thereto, which shall be of such construction as will permit the lamp to be made of sufficient size to furnish the required amount of light.

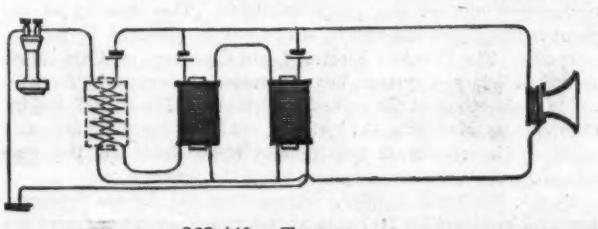
363,562. Electrolyte; A. C. Tichenor, of San Francisco, Cal. Application filed June 7, 1886. The electrolyte is an earth composed of silica, peroxide of iron, alumina, lime, magnesia and sulphuric acid, mixed with water.

(1) 363,567. Lighting Arrester; (2) 363,568. Incandescent Lamp Fixture; M. J. Wightman and H. Lemp, of Hartford, Conn. Application filed Aug. 19, 1886. (1) Novel structural details. (2) A lamp fixture in which the key for controlling the circuit of the lamp will operate to establish or disrupt the circuit between two terminals when the key is turned in either direction.

365,574. Mail Box Indicator; C. M. Ball, of Boston, Mass., and T. J. McTighe, of New York, N. Y. Application filed Dec. 2, 1886. Mail boxes usually located on the ground floor of large buildings are fitted with electrical devices which communicate with each room, and will indicate to the occupants when mail has been deposited in the box for them.

363,611. Electric Arc Lamp; J. F. Denison, of New Haven, Conn. Application filed May 24, 1886. Carbons of peculiar construction are arranged in a magazine from which they are fed out successively.

363,623. Electric Lock; M. S. Flowers, of Springfield, Assignor of one-half to J. E. Jones, of Greene County, Missouri.



363,449. TELEPHONY.

Application filed Nov. 18, 1886. Electrical means are provided for holding the lock bolts either in an open or closed position.

(1) 363,644. Electric Temperature Controlling Device; (2) 363,645. Electric Temperature Controlling Device; Henry Jacobs, of Fond du Lac, Wis. Application filed Sept. 27, 1886. In these devices an expansible diaphragm located in a closed chamber is connected by leverage with a valve which it controls when the diaphragm is caused to move by the pressure of air or other fluid.

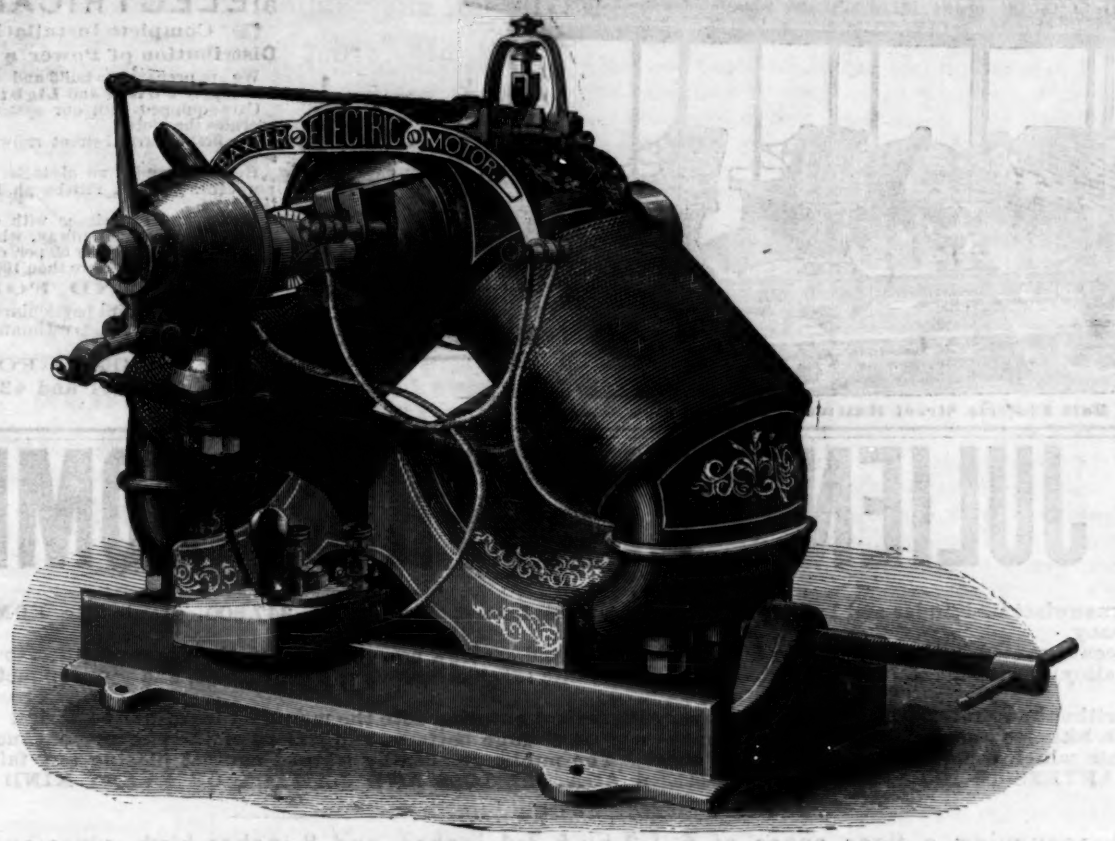
363,669. System of Conversion of Electrical Energy into Mechanical Force; H. M. Paine, of Newark, N. J. Application filed Jan. 14, 1887. This invention consists in combining with a source of electricity of a certain E. M. F. and its circuit several electric motors of varying sizes, in which the same electrical resistance is maintained by a special winding.

Copies of the specifications and drawings complete of any of the patents mentioned in this record—or of any other patent issued since 1866—can be had from this office for 25 cents. Give the date and number of patent desired, and address Johnston's Patent Agency, Potter Building, New York.

THE BAXTER ELECTRIC MOTOR.

This Motor is Now Ready to be Placed Upon the Market.

MANUFACTURED FOR BOTH ARC AND INCANDESCENT CIRCUITS.



THE ONLY PERFECTLY GOVERNED MOTOR EVER MADE

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THE BAXTER ELECTRIC MANUFACTURING AND MOTOR CO., 11 SOUTH STREET, BALTIMORE, MD.

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WE GLADLY TESTIFY to the SUPERIORITY of the
MUNSON
Eagle and Dynamo Electric Light Belt.
The stretch, otherwise than the elasticity, is removed, no rivets and perfect evenness in belt, the result, noiseless with a perfect motion, which is absolutely essential for a steady light. We use no other make. The character and responsibility of the house is unquestioned.

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W. J. Buckley, Man. Ft. Wayne Jenney El. Lgt. Co.
Thomson-Houston Electric Light, Herbert Wadsworth, Manager Western Office.
Brush Electric Co., Alex. Kempt, Special Agent.
Excelsior Electric Co., C. J. Reilly, Western Man.
Sperry Electric Light, Motor & Car Brake Co., 201 Royal Insurance Building
J. F. Reid, General Manager of the Mather Electric Light Co., Chicago.
Wm. H. Purdey, Com. of Public Works, Chicago.
John Mab, Chf. Engr. of Board of Trade, Chicago.
C. J. Melmes, Gen. Supt. Thomson-Houston Light, Omaha, Neb
J. A. Corbey, St. Joe Electric Light and Power Co., St. Joe, Mo.
Wm. Oswald, Agt. Edison Lgt. Co., N. Orleans La.
S. A. Duncan, Supt. Allegheny Co. Light Co. Pittsburgh, Pa.

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Long Life.
Portability.
Freedom from Salts.
No Evaporation.

This is an Open-Circuit Battery, and is shipped set up ready for immediate use, and requires no attention whatever.

PRICE PER SINGLE CELL, $2.00.

LIBERAL DISCOUNT FOR LARGE LOTS.

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DAFT SYSTEM.

Car on Daft Electric Street Railway, Los Angeles, Cal.

ELECTRIC RAILWAY MOTORS,

Separate, or Attached Directly to Street or other Cars.

Electric Light and Power Machines.

ELECTRICAL CONDUCTORS.

☞ **Complete Installation of Central Stations for the Distribution of Power a Specialty.**

We are prepared to build and equip railways with our Electric System and supply **Power** and **Light** Machines at the shortest notice.

Cars equipped with our system are lighted with the same current that operates the motor.

The first electrical street railway ever operated in America is run by our system.

Heaviest grades no obstacle. We are now building a road with a 14 per cent. grade in Pittsburgh, Pa., and have guaranteed successful operation.

Two years' experience with our Electric System on the Baltimore & Hampden Electric Railway, which was formerly operated with horses, shows a saving of over 50 per cent. in the cost of operation, and an increase of speed of more than 100 per cent.

SEND FOR ESTIMATES.

On receipt of full particulars of your road, or of power wanted, we will send you exact estimates for equipping and operating it by our system.

SEND FOR CIRCULARS.

Office, 41 and 43 Wall Street, New York.

Factory, Greenville, N. J.

THE JULIEN ELECTRIC COMPANY.

Our Storage Batteries are manufactured under and by virtue of United States Letters Patent, No. 347,300, granted to EDMOND JULIEN, Aug. 10, 1886; thereafter assigned to this company.

This Patent is the most recent granted in this country for Storage Batteries, and covers a new principle in their manufacture, to wit: **INOXIDIZABLE SUPPORT PLATES** (formed of our special alloy), "with an active matter consisting of metallic salt," etc., etc., applied thereto, and "a conducting liquid containing bioxide of hydrogen."

This Patent was granted without any interference, and covers every ingredient entering into the manufacture of our batteries.

Two companies, engaged in hitherto unsuccessful attempts to make a good storage battery, and jealous of the phenomenal success of this Company, are now in the field claiming to own Patents which come in conflict with the above. The public are hereby warned against placing any faith in their misrepresentations.

THIS COMPANY GUARANTEES TO PROTECT ITS CUSTOMERS AGAINST LOSS AND DAMAGE OF EVERY KIND ARISING FROM THE USE OF ITS BATTERIES.

Our regular type cell, occupying a floor space of 6 1-2 by 5 3-4 inches, and 8 inches high, gives over 2 volts during the entire period of discharge and 125 ampere hours, leaving about 20 per cent. of the charge in the cell. The cell will take a charge of 180 ampere hours, and with proper manipulation as high as 160 ampere hours may be taken out.

The highest resistance we have been enabled to discover after a careful test never exceeds .005.

The product of this Company at present is over 2,000 pounds a day, and increasing daily.

Orders to be filled should be booked several weeks in advance.

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COMBINATION OF GAS AND ELECTRIC LIGHT INTERESTS.

The American System the Pioneer of the New Departure.

ELECTRIC LIGHTING AS DEMONSTRATED BY THE

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ST. PAUL GAS COMPANY, St. Paul, Minn., State of Minnesota.
CITIZENS' GAS LIGHT CO., Jacksonville, Florida, State of Florida.
SOWDON, ELDER & WRIGHT, 131 Devonshire St., Boston, New England States (except Connecticut).
PITTSBURGH ELECTRIC CO., EUGENE INGOLD, General Manager, 213 Wood St., Pittsburgh, Pa., Western Pennsylvania, Ohio, Kentucky and West Virginia.
J. M. CHIPMAN, 19 N. Pennsylvania St., Indianapolis, Ind., State of Indiana.
MARKLE ENGINEERING COMPANY, Detroit, Mich., State of Michigan.

This company has challenged all other systems to a competitive test of merit without response.

For completeness and simplicity of construction, durability, and economy in operation, steadiness and quality of light produced, and perfection in automatic regulation, **THE AMERICAN SYSTEM HAS NO EQUAL.**

The Wood Automatic Regulator is entirely original, absolutely perfect in operation, and is the only perfect automatic current regulator ever invented, the pretensions of rival companies to the contrary notwithstanding.

It still invites comparison, and stands ready to meet any known system of Electric Arc Lighting in open fair competitive tests, upon all points of superiority claimed for its apparatus whenever and wherever a sale is guaranteed to the winner.

POINTS OF EXCELLENCE.

The Wood Automatic Regulator is the only known invention that is perfect in its action for regulating the lamps better on long and short circuits.

It saves oil and commutator brushes.

The American system needs less care, and is run at much less expense than any other system.

Its apparatus occupies less space, weighs less, and requires less motive power for carrying any given number of lights than any other.

Its lights are steadier, and it requires less skill than any other to operate its apparatus.

The American system guarantees absolute safety of armatures from burning. This no other company can do, and it is this burning out of armatures in other systems that makes maintenance so expensive.

The American company stands pledged to make good all their claims to any one desiring an Electric Plant of any kind.

ITS ALLIANCE WITH THE GAS COMPANIES. A new element of enormous power is now coming into the company's concerns. The gas interests of the country have been converted to the commercial value of electric lighting as a business enterprise, the particular value of the system owned by this company, and its strong business alliance with the gas property of this company, is worthy of serious consideration of all purchasers of Electric Light Apparatus. **ADDRESS ALL COMMUNICATIONS TO**

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